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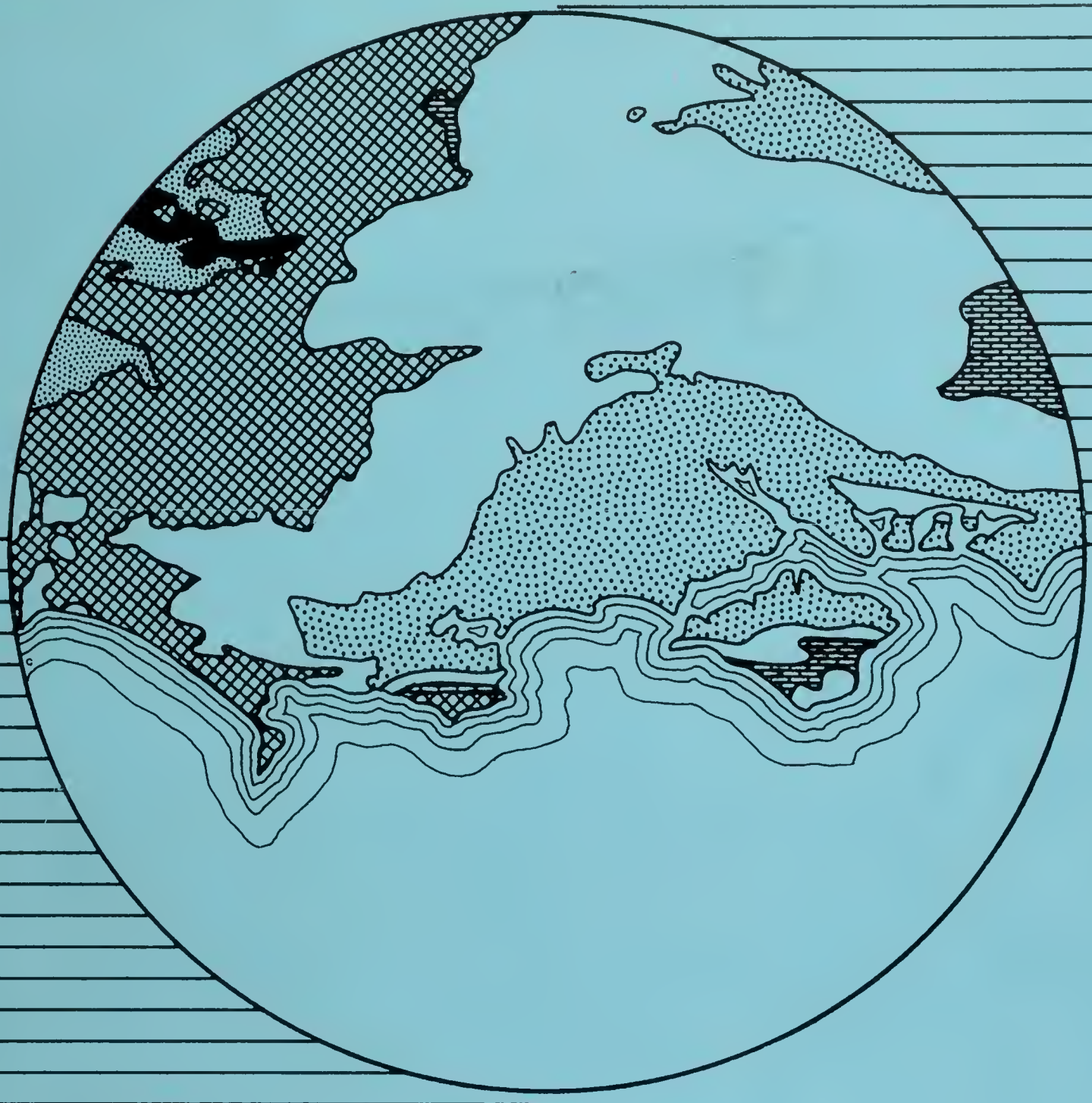
MICROPALAEONTOLOGICAL SOCIETY



MESOZOIC AND CENOZOIC STRATIGRAPHICAL MICROPALAEONTOLOGY OF THE DORSET COAST AND ISLE OF WIGHT SOUTHERN ENGLAND

EDITORS: A.R. LORD and P.R. BOWN

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MESOZOIC AND CENOZOIC STRATIGRAPHICAL MICROPALAEONTOLOGY OF THE DORSET COAST AND ISLE OF WIGHT, SOUTHERN ENGLAND.

Field Guide for the XXth. European Micropalaeontological Colloquium.

Edited by

A. R. Lord and P. R. Bown

British Micropalaeontological Society
Guide Book 1
1987

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FOREWORD

The British Micropalaeontological Society is pleased to welcome delegates of the XXth. European Micropalaeontological Colloquium to Britain. The itinerary is very similar to that followed by the IIIrd. Colloquium, which visited Dorset and the Isle of Wight in 1956. It is surely appropriate to revisit these classic coastal sites, in part to introduce a new generation of European colleagues to the geological and scenic attractions of southern England but also to note the volume and diversity of micropalaeontological work carried out during the intervening 3 decades. The guide is arranged stratigraphically and designed to assist other workers who follow in the footsteps of the Colloquium along the shores of Dorset and the Isle of Wight.

Alan Higgins

Chairman, British Micropalaeontological Society.

B.P. Research Centre.

BRN 178534
HN 401351

ACKNOWLEDGEMENTS

Organisation of the Colloquium and production of the guide book have been assisted by many people, not least of all the contributors who have filled the following pages, but we would like to particularly acknowledge the help of the following people -

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From University College London: Dr. Janis Cushnie, Miss Sheila Gair, Mr.L.T.Gallagher, Mr.G.K.Gillmore, Dr. Minoo Lord, Miss Florence Lowry, and a special acknowledgement to Mr.C.Stuart and Mrs. Janet Baker who redrew all the maps and diagrams.

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July 1987.

Editorial Note: Author usage of terms such as "Lower" or "Early" and taxonomic style have been left largely as originally submitted. The text was prepared using a "BBC Micro"word-processing system which does not allow inclusion of accents.

The European Micropalaeontological Colloquia

The colloquia started in the early 1950's largely as a result of liason between Jacques Sigal (France), Helmut Bartenstein (West Germany) and Tom Barnard (Great Britain). The meetings were designed to provide an opportunity for European micropalaeontologists to collect comparative samples from classic localities in each others countries and, of course, equally important, to meet and talk in an informal setting. The colloquia have become larger with the passage of years and the guide books have tended to become increasingly sophisticated productions (a trend we have consciously tried to reverse here), but certain guiding precepts have remained:

1. The Colloquia are informal field collecting exercises and no papers are presented.
2. Each Colloquium is self-contained and there is no continuing organisation beyond the delegates present, who agree the venue of future Colloquia in the light of invitations received.

1954	France (Paris Basin)
1955	North Germany
1956	Great Britain (Dorset and Isle of Wight)
1957	France (Aquitaine Basin)
1958	Italy (Milan - Rome)
1959	Germany (Mainz Basin, Aselfingen)
1961	The Netherlands and Belgium
1963	Austria (Vienna Basin)
1965	Switzerland
1967	Poland
1969	Great Britain (southern and central England)
1971	U.S.S.R.
1973	Spain
1975	Rumania
1977	Denmark
1979	Yugoslavia
1981	Germany (Bavaria)
1983	Czechoslovakia
1985	Italy (Sardinia)
1987	Great Britain (Dorset and Isle of Wight)

INTRODUCTION

This Micropalaeontological guide has been prepared primarily for delegates attending the XXth. European Micropalaeontological Colloquium (26th. August - 7th. September 1987) and thus contains basic material about the geology and stratigraphy of sections in addition to information about the microfossil content of the rocks. It is, however, intended that the book should be of use to the general scientific community beyond the duration of the Colloquium. To assist this process all the material studied - slides, residues and some unprepared sediment - has been deposited in the Department of Palaeontology, British Museum (Natural History).

The rocks exposed on the coasts of Dorset and the Isle of Wight have attracted the attention of geologists for as long as the discipline has had a name, and longer. Yet, well-known as these areas are, they continue to challenge and provide new data for our consideration. The discovery of oil in east Dorset and especially the North Sea focused our attention on the source and reservoir potential of the Jurassic rocks and the nature of their organic content, including the long known oil seeps along the coast. The understanding of the structure of what at first sight seems a relatively simple region has also improved greatly in recent years, partly because of increased availability of seismic data but also as a result of new concepts of folding and faulting. The history of development and the geometry of the Wessex Basin in all its aspects is now known to be complex and continues to present problems for our consideration.

CONTRIBUTORS

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D O R S E T

Introduction.

The coast line of Dorset provides an excellent view of the Mesozoic - sediments, fossils, structure and economic geology - that has attracted the attention of geologists since the earliest days of our science. The significance of the area is attested by the presence of three stage stratotypes: Kimmeridgian, Portlandian and "Purbeckian". The level of exposure is matched by that of the Jurassic and Cretaceous of the Yorkshire coast in north-east England, but Dorset has been more extensively studied. The Dorset coast has attracted the attention of palaeontologists in particular and has been the subject of pioneer work on the development of the standard ammonite zonation (e.g. Lang 1914-1936, Lang and Spath 1926, Lang et al. 1923, 1928, Arkell 1933, Cope 1967, 1978). This fact, combined with the excellent stratigraphic control provided by published bed-by-bed descriptions (e.g. Lang 1914-1936, Arkell 1947, Blake 1875, Torrens 1969), the virtually continuous exposure and the dominance of argillaceous sediments has made the coastal sections ideal for micropalaeontological investigation. More recently, oil exploration in the Wessex Basin and the drilling of British Geological Survey boreholes have provided further impetus to micropalaeontological studies in Dorset as a means of evaluation and correlation of subsurface Jurassic sequences.

This account considers the Jurassic only, with the Cretaceous analysed via the Isle of Wight exposures. A marine sequence from the latest Triassic (Rhaetian) to the Upper Jurassic has been studied together with material from the Upper Jurassic/Lower Cretaceous non-marine Purbeck facies. Gaps occur in the record for reasons of exposure and facies - the largely decalcified Bridport Sands (Toarcian) has not been studied, the Aalenian

and Bajocian are represented by condensed carbonates, much of the Bathonian and Callovian is poorly exposed and substantial parts of the Kimmeridge Clay contain no calcareous fossils, including the type section in Kimmeridge Bay. The sampling was by no means exhaustive and was designed to provide a representative view of the micropalaeontology of the Dorset coast Jurassic.

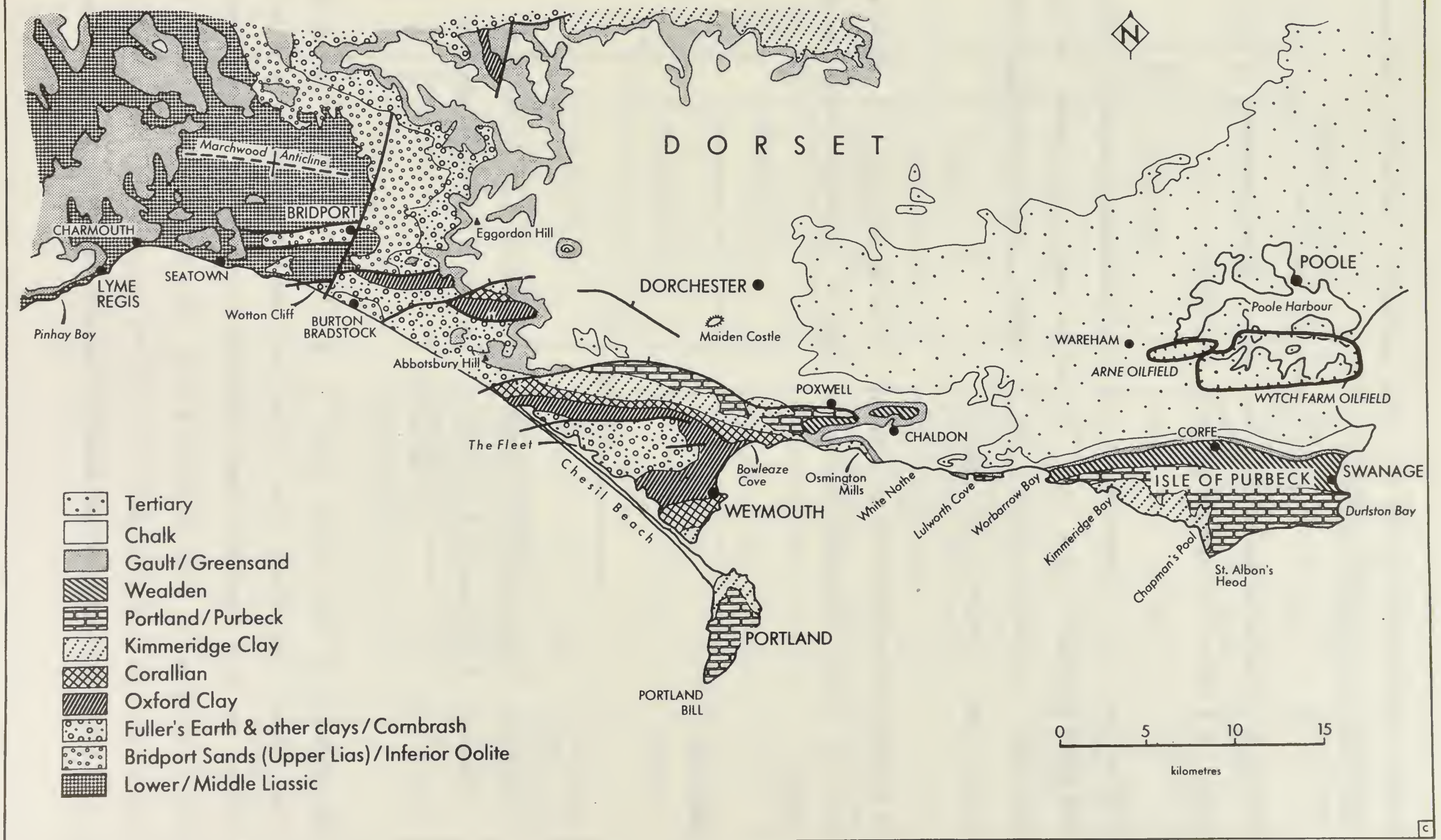
Major Sources

Arkell, W.J. (1947)
"Geology of the Country around Weymouth, Swanage, Corfe and Lulworth". Memoirs of the Geological Survey of Great Britain, xii + pp. 386.

Cope, J.C.W., Getty, T.A., Howarth, M.K., Morton, N. and Torrens, H.S. (1980).
"A correlation of Jurassic rocks in the British Isles. Part One: Introduction and Lower Jurassic". Geological Society of London, Special Report 14, pp. 73.

Cope, J.C.W., Duff, K.L., Parsons, C.F., Torrens, H.S., Wimbledon, W.A. and Wright, J.K. (1980).
"A correlation of Jurassic rocks in the British Isles. Part Two: Middle and Upper Jurassic". Geological Society of London, Special Report 15, pp.109.

Wilson, V., Welch, F.B.A., Robbie, J.A. and Green, G.W. (1958).
"Geology of the Country around Bridport and Yeovil". Memoirs of the Geological Survey of Great Britain, xii + pp. 239 (pub. 1959).


DORSET
Marchwood Anticline
BRIDPORT
CHARMOUTH
LYME REGIS
Pinhay Bay
SEATOWN
Wotton Cliff
BURTON BRADSTOCK
Eggordon Hill
DORCHESTER
Maiden Costle
Abbotsbury Hill
The Fleet
Chesil Beach
Bowleaze Cove
Osmington Mills
WEYMOUTH
PORTLAND
PORTLAND BILL
POXWELL
CHALDON
White Nothe
Lulworth Cove
Worbarrow Bay
Kimmeridge Bay
Chapman's Pool
St. Albon's Head
Durlston Bay
ISLE OF PURBECK
SWANAGE
CORFE
POOLE
Poole Harbour
WAREHAM
ARNE OILFIELD
WYTCH FARM OILFIELD
N
Tertiary
Chalk
Gault / Greensand
Wealden
Portland / Purbeck
Kimmeridge Clay
Corallian
Oxford Clay
Fuller's Earth & other clays / Cornbrash
Bridport Sands (Upper Lias) / Inferior Oolite
Lower / Middle Liassic
0 5 10 15
kilometres
C

Guides: several guides to the area are available, reflecting different levels and directions of interest:

Geologist' Association Guide 22: "The Dorset Coast from Poole to Chesil Beach" M.R.House (new edition in press July 1987).

International Field Symposium on the British Jurassic "Guide for Dorset and South Somerset" J.C.W. Cope, A. Hallam and H.S. Torrens. Geology Department, University of Keele, pp. 71 (1969). Cited in References under Editors name - Torrens, H.S. (1969).

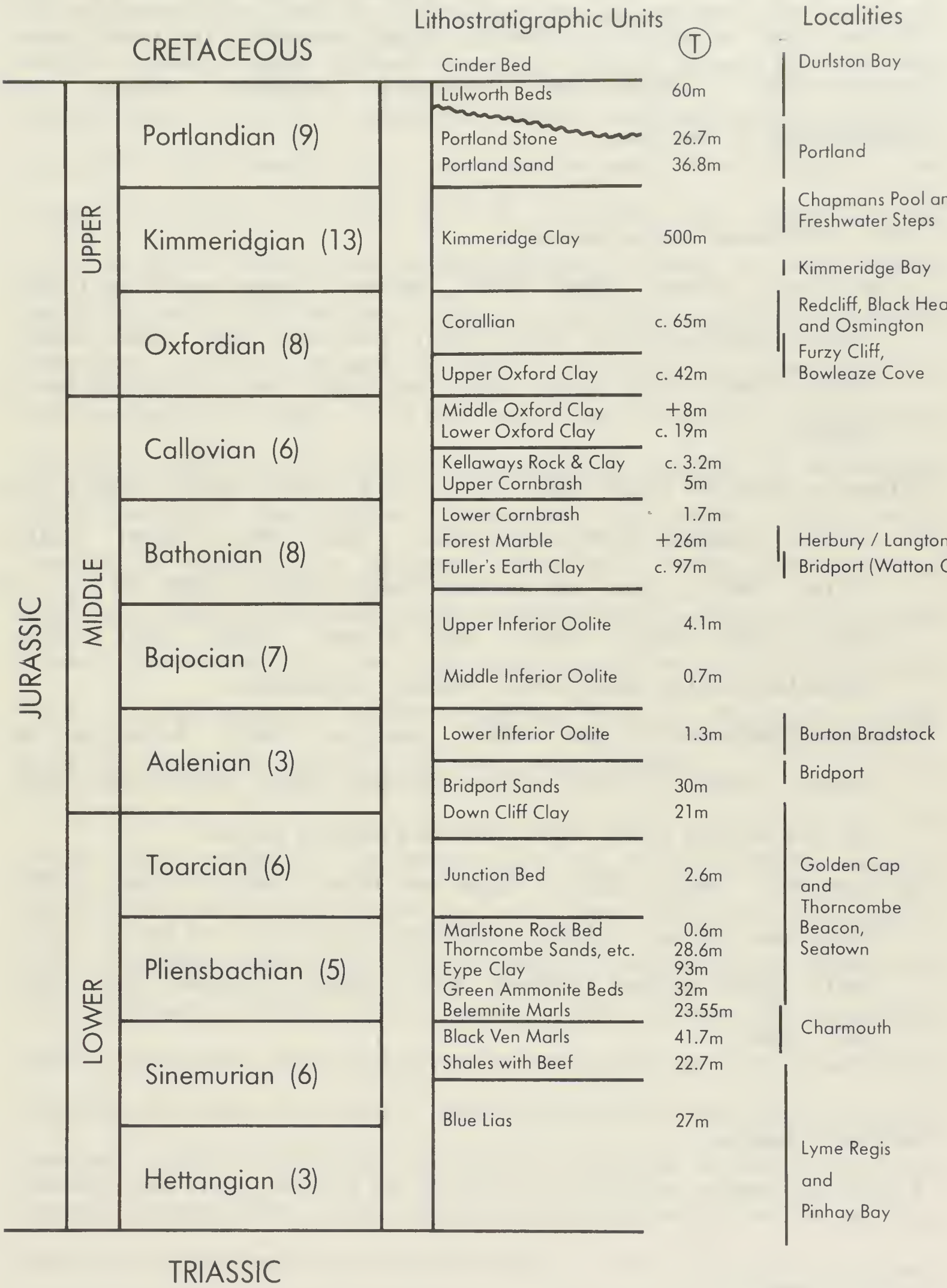
"A Field Guide to the Petroleum Geology of the Wessex Basin" R. Stoneley and R.C. Selley. Department of Geology, Imperial College London, pp.44 (1986).

(ARL, PC)

JURASSIC

A.R. Lord, P. Copestake, I.D. Boomer, L.M.Sheppard, N.G. Fuller, R.G. Clements, P.R. Bown, J.B. Riding, D.J. Batten, K.K. Lister and A.M. MacLennan

The Jurassic of the Dorset Coast is a classic reference section of international importance. The lithostratigraphy and biozonation of this sequence has been summarised and discussed by Cope et al. (1980a, 1980b) with correlations to numerous other British sections. The Dorset coast is rivaled in Britain only by the fine sections exposed on the Yorkshire coast although, sadly, inland exposures between these two cliff sites are



(5) = zones in stage

(T) = thickness in area of Dorset visited

now becoming rare. The Dorset coast has been intensively studied for over 150 years and an extensive literature exists concerning the stratigraphy, palaeontology, sedimentology, structure, economic geology and geomorphology of the area.

Source references for microfossils

Foraminifera: Barnard (1950, 1953), Barnard, Cordey and Shipp (1981), Cifelli (1959), Coleman (1981, 1982), Copestake and Johnson (1981), Gordon (1965), Lloyd (1959, 1962), Macfayden (1941), Shipp and Murray (1981).

Ostracoda: Anderson (1939, 1966, 1971, 1973, 1985), Barker (1966), Bate (1978), Clements (1969, 1973), Field (1966, 1968), Forbes (1851), Fuller (1983), Jones and Sherborn (1888), Kilenyi (1969, 1978), Lord (1972, 1974, 1978), Neale and Kilenyi (1961), Park (1985), Sylvester-Bradley (1948, 1949), Whatley (1964,1965).

Calcareous Nannofossils: Bown (1987), Hamilton (1982), Barnard and Hay (1974), Dockerill (1987), Gallois and Medd (1979), Medd (1982), Rood, Hay and Barnard (1971, 1973), Rood and Barnard (1972).

Palynomorphs: Downie (1957), Fisher and Riley (1980), Gitmez (1970), Gitmez and Sarjeant (1972), Ionnides, Stavrinos and Downie (1977), Lentz (1958), Mebradu (1978a,b), Norris (1965), Sarjeant (1960, 1962), Wall (1965).

Reference Samples

A suite of samples collected by A.R.Lord was studied by all contributors.

General Comments

Foraminifera (P. Copestake)

W.D. Lang not only undertook the earliest detailed descriptions of the

Dorset coast Jurassic but he also stimulated the first investigations of the foraminifera by providing samples for the work of Macfayden (1941) and Barnard (1950). These authors were the first to appreciate the wide morphological variation in species of Jurassic foraminifera, as testified by their long synonymy lists. This was Barnard's first work on the Jurassic nodoariids, which led him to introduce the concept of the evolving species plexus, an aspect persued further in later papers. Barnard's paper (1950) on the Dorset Lias described foraminifera from the Hettangian - Lower Pliensbachian interval, including two important marker species, Dentalina langi (a widespread index for the late Hettangian - earliest Sinemurian in Britain) and Epistomina liassica (a widespread marker species in the European Sinemurian, now known to be a junior synonym of Reinholdella margarita (Terquem)). Whilst the works of Macfayden (1941) and Barnard (1950) suggested the diversity of the Dorset foraminiferal assemblages, many more taxa are present than they describe. These include important marker species such as Neobulimina sp.2, Astacolus semireticulata and Marginulina prima spinata.

Cifelli (1959) published the first paper on British Middle Jurassic foraminifera, based primarily on the Dorset coast Bathonian. This paper is still valuable today and Cifelli's "faunules" (or foraminifer zones) are now recognised at least as far north as Bath (Coleman 1981). Coleman (1982) subsequently described Bathonian (and Lower Jurassic) foraminifera from the Winterbourne Kingston Borehole and also produced a brief but important account of Bajocian foraminifera from the offshore Lyme Bay Borehole (Coleman 1980). The coastal Bajocian outcrops have not yet been described for foraminifera. The Callovian of the area has also been neglected by students of foraminifera, compared to other British sections, although Medd (1982) briefly records Callovian foraminifera from the

Winterbourne Kingston Borehole.

The Upper Jurassic has been the focus of most of the research on Dorset coast Jurassic foraminifera, particularly the Oxfordian (Barnard 1953, Gordon 1965, Barnard, Cordey and Shipp 1981 and Medd 1982). Whilst the Kimmeridgian is known to be rich in foraminifera, only part of the assemblage has been published upon. Lloyd's first paper (1959) described the agglutinating foraminifera whilst the polymorphinids, miliolids and rotaliids were discussed in a subsequent paper (1962). The dominant foraminiferal group, the nodosariids, has still to be described in detail. The Portlandian of the area has never been the subject of a systematic foraminiferal study, even though, as the present report shows, foraminifera are present at certain levels. The only previous record is of the ubiquitous Lenticulina muensteri from the Portland Stone (Shipp and Murray 1981).

Ostracods (N.G. Fuller)

Some comments on the nature of Callovian - Oxfordian - Kimmeridgian Ostracod faunas of the Dorset coast between Weymouth Bay and Chapman's Pool.

1. Fuller (Palaeontological Society Monograph, in preparation) is the first major review of Callovian - Oxfordian ostracods since Whatley's (1964) unpublished thesis and some minor work in the top of the Oxfordian by Kilenyi (1969, 1978). The fauna contains many previously undescribed species.

2. Many of the so-called "micro-ostracods" (adults <0.5mm long) have emerged as new species and/or genera. Because of their small size, study by conventional binocular microscope is frequently inadequate and extensive use has to be made of the scanning electron microscope to

elucidate the fine details.

3. Environmentally the Callovian - Kimmeridgian period shows a change from the widespread open marine conditions in which the Oxford Clay Formation was deposited, to the shallowing, basin margin conditions of the Corallian sequence with a subsequent reimposition of deeper water, open marine shale deposition in the Kimmeridge Clay Formation. The ostracod faunas in a wider geographic sense across N.W. Europe show a broad uniformity in Oxford Clay and Kimmeridge Clay times, but in the intervening Corallian they appear to become restricted both in the geographic sense and on the Dorset coast by rapidly changing environmnetal conditions, showing distinct facies dependency. This is particularly illustrated by the wide diversity at the top of the Upper Oxford Clay in contrast with some of the thin clays within the Osmington Oolite Formation which incline to being monospecific (e.g. D42) or the upper, calcareous beds of the Nothe Clay (e.g. D35). Useful further work could be carried out on the relationship between facies type and ostracod diversity. This may well help to refine useful, correlatable index species.

4. The basic faunal development through this section shows the diminution of typical "Middle Jurassic" faunas characterised by taxa such as Praeschuleridea Bate, Pleurocythere Triebel, Bythoceratina (Praebythoceratina) Grundel and Kozur, and their replacement by typically "Upper Jurassic" faunas containing taxa such as Galliaecytheridea Oertli, Macrodentina Martin, Mandelstamia Lyubimova and Protocythere Triebel. Of some importance is the break between the Middle and Upper Oxfordian (tenuiserratum/regulare zones) which heralds the influx of large numbers of Galliaecytheridea and Macrodentina species and the demise of the Terquemula Blaszyk and Malz and Nophrecythere Grundel groups. Underlying all this there is,

of course, a constant presence of genera such as Macrocypris, Paracypris, Cytherella, Cytherelloidea and many different species of small genera such as Eucytherura, Procytherura and Pseudocythere.

Calcareous Nannofossils (P.R. Bown)

The Jurassic of the Dorset coast has been the subject of a relatively large amount of calcareous nannofossil research, including the work of Rood, Barnard and Hay (1971 - 1973) which led to the widely cited Jurassic Calcareous Nannofossil Zonation scheme of Barnard and Hay (1974). The nannofossil record from this succession, however, is rather inconsistent, with nannofossil recovery often poor due to facies, diagenetic dissolution and geological age.

In the Hettangian and Sinemurian, nannofossils are often rare or absent and low in diversity. This is thought to reflect the sporadic way in which nannofossils moved into the newly opened N.W.European shelf sea from the Tethyan area were they are first recorded in the Norian/Rhaetian. Throughout the Lower Jurassic (and probably through the entire Jurassic) evolutionary activity was concentrated in the Tethyan Realm and movement into the northern shelf sea was often delayed; the appearance of new species in N.W.Europe is often recorded several ammonite zones later. By Sinemurian times the presence of nannofossils is more consistent and a typical early Lower Jurassic assemblage is established, characterised by Crucirhabdus primulus, Mitrolithus elegans, Parhabdolithus liasicus and Schizosphaerella punctulata. In the Pliensbachian these components are augmented and gradually replaced by new forms, particularly the newly evolved and rapidly diversifying placoliths e.g. Biscutum and Lotharingius. In Toarcian times the turnover of nannofloral assemblages is complete and a far more diverse late Lower Jurassic assemblage is

observed, typified by Biscutum novum, Discorhabdus ignotus, Sollasites spp. (Biscutaceae), Axopodorhabdus atavus (Podorhabdaceae), Lotharingius hauffii, Lotharingius sigillatus, Bussonius prinsii (Watznaueriaceae), Calyculus spp., Carinolithus superbus (Calyculaceae) and Crepidolithus cavus (Zygodiscaceae). Seven coccolith families are present by Toarcian times and these form lineages from which all later Jurassic and Cretaceous coccoliths can be traced (Bown 1987).

The dominance of watznaueriacean coccoliths first observed in the Toarcian i.e. Lotharingius spp., is carried on into the Middle Jurassic with Watznaueria spp. particularly abundant. In addition, the Middle Jurassic sees the diversification of the Podorhabdaceae, e.g. Ethmorhabdus, Hexapodorhabdus, Octopodorhabdus, development of the Family Retacapsaceae (Retacapsa, Polypodorhabdus) and the initiation of the distinctive genus Stephanolithion. The Upper Jurassic nannofloras are essentially similar to those of the Middle Jurassic, the dominance of Watznaueria spp. continues (e.g. Kimmeridge coccolith limestones particularly). The low diversity which is often observed throughout the Jurassic is most likely due to diagenetic dissolution which selectively destroys less dissolution resistant forms e.g. Stradnerlithus spp., leaving robust, resistant forms such as Watznaueria spp., Crepidolithus spp. and Schizosphaerella punctulata.

THE LOWER JURASSIC - LYME REGIS TO BRIDPORT

The coastal cliffs expose an essentially complete Lower Jurassic sequence some 320m thick and dominantly composed of mudrocks (Figs.1-7). The Hettangian and Sinemurian are particularly bituminous and provide a source

rock, whereas the Toarcian sands form the upper reservoir level of the Wytch Farm Oilfield in east Dorset. The units have a regional dip eastwards towards the Weymouth Anticline and many of the hills are capped by horizontal mid-Cretaceous shallow-water deposits that rest unconfomably upon the Lower Jurassic.

Notes:

1. The Lower Jurassic is not fully represented on the Dorset coast. Ammonite biostratigraphy has demonstrated that gaps exist in the Upper Sinemurian - the oxynotum zone and upper part of the obtusum zone are missing as is the upper part of the raricostatum zone. The time gaps occur within and at the top of the Black Ven Marls.

2. For the Lower Lias (Hettangian = Lower Pliensbachian) bed numbers from the pioneer work of W.D. Lang are used as a standard reference system (various publications 1914-1936). The cliffs are not those Lang measured and some of his units are difficult to recognise. Although the sections and their ammonite assemblages are well known, no comparable modern work exists other than the revisions of Palmer (1972a, b).

Pinhay Bay to Lyme Regis (SY320908 - SY340920)

The only Triassic studied occurs in Pinhay Bay, to the east of the Pinhay Fault where the top of the Penarth Group (Rhaetian) can be seen. The White Lias consists of lithologically varied carbonates including intraformational conglomerates, slump beds and features such as mud cracks and algal laminae, indicating deposition in very shallow waters (Hallam, 1960). Sample D1 was taken from a shale parting below the topmost limestone of the White Lias.

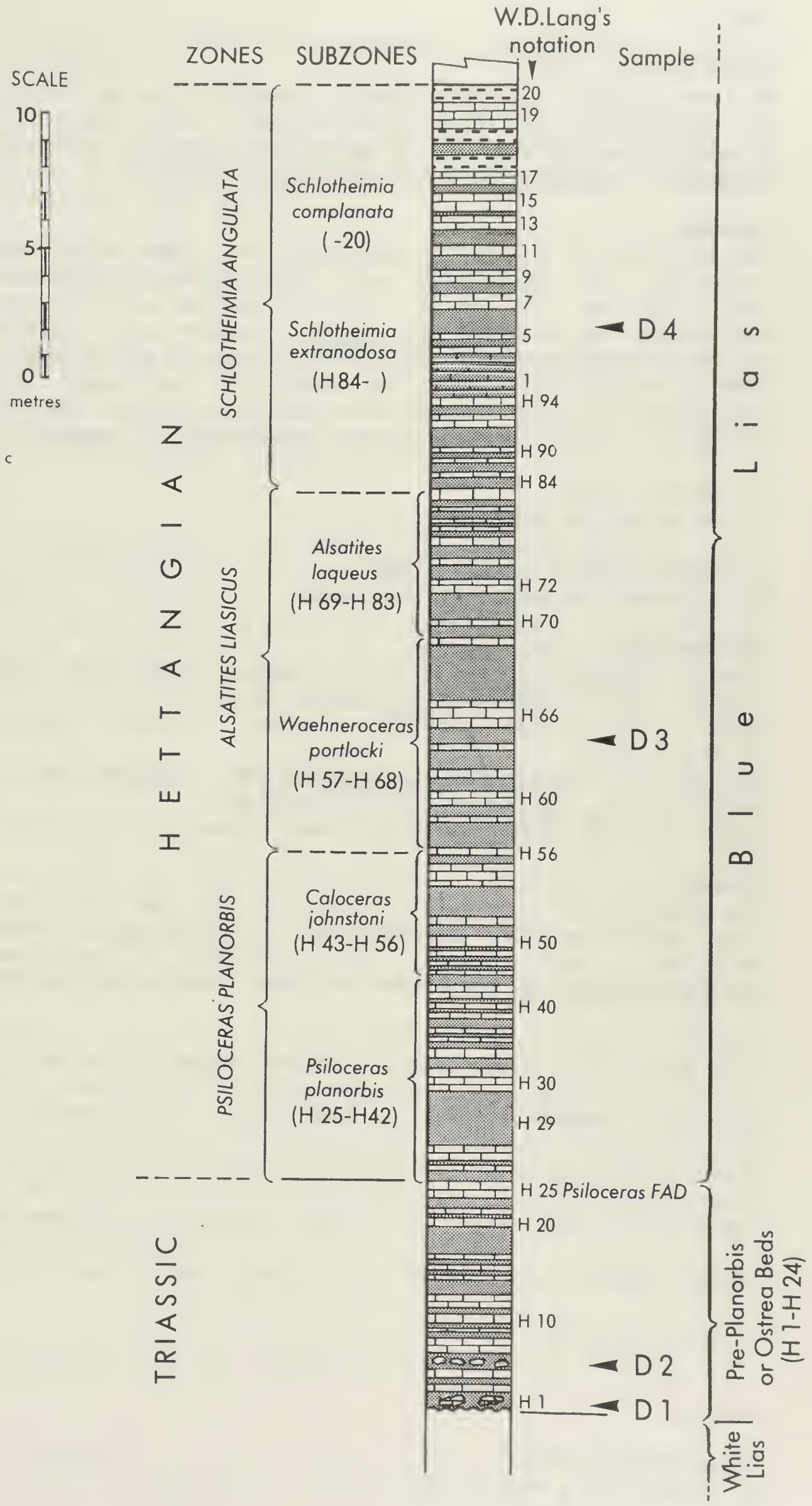


Fig. 1. Triassic-Jurassic boundary sequence and the Blue Lias (Hettangian part). (Redrawn after Cope, Hallam and Torrens 1969).

Sample D1

FORAMINIFERA (PC)
No foraminifera recovered, however, samples from the Pinhay Bay White Lias in the author's collection have yielded a low diversity assemblage of foraminifera dominated by Eoguttulina liassica (Strickland) with rare Lingula cf. L.tenera Bornemann and Dentalina spp.

Comments
The abundance of E.liassica may represent a deviation from normal marine salinity, in accordance with the lagoonal hypersaline environment postulated for the White Lias by Hallam and El Shaarawy (1981). The occurrence of abundant E.liassica accompanied by occasional nodosariids is characteristic of the White Lias (and the equivalent Langport Member, Penarth Group). The species is typical of the Lower Jurassic and its occurrence in the Penarth Group represents one of the first influxes of "Jurassic" foraminifera below the first Jurassic ammonite Psiloceras.

OSTRACODA (IDB)
No ostracods recovered.

CALCAREOUS NANNOFOSSILS (PRB)
No calcareous nannofossils recovered.

PALYNOMORPHS (JBR)
Spores: Acanthotriletes varius Nilsson, Cyathidites australis Couper, C.minor Couper, ?Todisporites Couper sp..
Pollen: Alisporites thomasii (Couper) Pocock, Circulina granulata Adloff et al.
Acritarchs: Micrhystridium lymensis var. rigidum Wall, Micrhystridium Deflandre sp., Leiosphaeridia Eisenack sp..
Misc. microplankton: Tasmanites Newton sp..

Comments
The abundance of C.granulata is typical of the European Rhaeto-Liassic. The dominance of circumpolles (C.granulata) is indicative of a relatively warm climate. The occurrence of acanthomorph acritarchs (Micrhystridium) is suggestive of quiet, inshore marine conditions.

The White Lias is succeeded by shales, paper shales and limestones of the Blue Lias. Ammonites have not been found in the lowermost 2.5m (Lang beds H1-24) and the base of the Jurassic (base of Psiloceras planorbis Zone) is taken at Bed H25 where the oldest Psiloceras has been found (Cope et al 1980a). Sample D2 was taken in the Pre-Planorbis Beds, 1.5m above the base of the Blue Lias.

Sample D2

FORAMINIFERA (PC)
No foraminifera recovered.

OSTRACODA (IDB)
Monoceratina frentzeni Triebel and Bartenstein, Ogmoconchella aspinata (Drexler), Paracypris sp.1.

Comments
O.aspinata ranges from the lowermost Lower Jurassic to Lower Sinemurian and often dominates the assemblages (as here). The assemblage is typical of the marine lowermost Lower Jurassic.

CALCAREOUS NANNOFOSSILS (PRB)
No calcareous nannofossils recovered.

PALYNOMORPHS (JBR)
Spores: Acanthotriletes varius Nilsson, Cyathidites australis Couper.
Pollen: Alisporites thomasii (Couper) Pocock, Circulina granulata Adloff et al, ?Classopollis classoides Pflug.
Misc. microplankton: Tasmanites Newton sp..

Comments
The abundance of C.granulata is typical of the European Rhaeto-Liassic. The presence of Tasmanites sp. (in low numbers) is suggestive of a nearshore marine environment. The abundance of circumpolles (C.granulata) is indicative of a relatively warm climate. The assemblage is of extremely low diversity; an almost monospecific assemblage of C.granulata (many in tetrads). Very low levels of marine palynomorphs and high levels of unstructured and semistructured kerogen.

The Blue Lias forms the lower cliff from Pinhay Bay to Black Ven, east of Lyme Regis. The 29m thick sequence includes the entire Hettangian and basal Sinemurian. The characteristic lithology of alternating shales and limestones has been the subject of considerable attention in the past, having been studied in detail and each bed numbered by Lang (1924). The alternation appears to be both primary and secondary, reflecting both original sedimentary variation and later diagenetic segregation of calcite (Hallam, 1964). Large ammonites are common and numerous vertebrates, for which Lyme Regis is famous, have been collected in the past. Samples were collected through the sequence.

Sample D3 (Blue Lias Lang Bed H65; liasicus Zone, portlocki Subzone)
(SY32109085)

FORAMINIFERA (PC)
No foraminifera recovered.

OSTRACODA (IDB)
No ostracods recovered.

CALCAREOUS NANNOFOSSILS (PRB)
Crucirhabdus primulus Prins ex Rood, Hay and Barnard.

Comments
Low diversity, low abundance typical of Hettangian assemblages. C.primulus ranges from angulata Zone to tenuicostatum Zone (Lower Toarcian) in N.W.Europe. The rarity of calcareous nannofossils in Britain at this time is thought to reflect the early stage in calcareous nannofossil history, the first nannofossils being recorded from Tethys in only the previous stage i.e. Rhaetian. Their movement into N.W.Europe appears to have been somewhat sporadic. In addition, the older the rocks the greater chance of their diagentic destruction.

PALYNOMORPHS (JBR)
Spores: Kraeuselisporites reissingeri (Harris) Morbey, Todisporites minor Couper.
Pollen: Alisporites thomasii (Couper) Pocock, Circulina granulata Adloff et al., Chasmatosporites apertus (Rogalska) Nilsson, Chasmatosporites Nilsson sp., Classopollis classoides Pflug, ?Cycadopites nitidus (Balme) Pocock.
Microplankton: Leiosphaeridia Eisenack sp., Micrhystridium Deflandre sp., Tasmanites Newton sp..
Misc.: fungal spore indet..

Comments
C.granulata/C.classoides dominance typical of the British Rhaeto-Liassic strata. K.reissingeri is a Rhaetian to early Sinemurian marker. The dominance of the circumpolles group is suggestive of a relatively warm climate. Marine palynomorph influence is very low - indicative of a nearshore environment.

Sample D4 (Blue Lias, Lang Bed 6; angulata Zone, extranodosa Subzone)
(SY32859100)

FORAMINIFERA (PC)
Dentalina nodigera Terquem and Berthelin, D.pseudocommunis Franke, D.sinemuriensis Terquem, D.subtenuicollis Franke, Lingulina tenera substriata Norvang, Marginulina prima incisa (Franke), Planularia inaequistriata (Terquem), Spirillina / Cornuspira / Ammodiscus pyritised cast.

Comments
Diagnostic assemblage of the British latest angulata-bucklandi Zones, particularly the abundance of M.prima incisa. The presence of L.tenera substriata indicates an age no younger than early bucklandi Zone (conybeari subzone) which is its youngest recorded range in Britain, although at several British localities this taxon disappears at the top of the angulata Zone.

OSTRACODA (IDB)
Monoceratina frentzeni Triebel and Bartenstein, Nanacythere aequalicostis Park, Nanacythere elegans (Drexler), Nanacythere sp., Ogmoconchella aspinata (Drexler), Ogmoconchella bispinosa (Grundel), Ogmoconchella hagenowi Drexler, Paracypris sp.I, Polycope cerasia

Blake.

Comments
As in D2, O.aspinata is still present. N.aequalicosti was recorded by Park (MS) only within the angulata and bucklandi Zones of Dorset. The assemblage marks the first appearance of cytheracean ostracods.

CALCAREOUS NANNOFOSSILS (PRB)
Crucirhabdus primulus Prins ex Rood et al., Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood et al.

Comments
Assemblages dominated by C.primulus and P.liasicus typify the British early Lower Jurassic.

PALYNOMORPHS (JBR)
Spores: Cyathidites minor Couper, Cyathidites Couper sp., Kraeuselisporites reissingeri (Harris) Morbey.
Pollen: Alisporites thomasii (Couper) Pocock, Chasmatosporites apertus (Rogalska) Nilsson, Circulina granulata Adloff et al., Podocarpidites Cookson ex Couper sp..
Acritarchs: Micrhystridium lymensis var. rigidum Wall, M.recurvatum Valensi, Micrhystridium Deflandre sp..
Prasinophycean algae: Tasmanites Newton sp..
Dinoflagellate cysts: Dapsilidinium? langii (Wall) Lentin and Williams

Comments
D.? langi is a marker for the uppermost Rhaetian to Hettangian, K.reissingeri is a marker for the Rhaetian to early Sinemurian. The abundance of C.granulata is indicative of a relatively warm climate, acanthomorph acritarchs (Micrhystridium) suggest a quite, nearshore environment. C.granulata dominates the assemblage and the there is a relatively low level of marine elements.

Sample D5 (Blue Lias, Lang Bed 46, bucklandi Zone, bucklandi subzone)
(SY33359150)

FORAMINIFERA (PC)
Ammodiscus siliceus (Terquem), Dentalina pseudocommunis, Dentalina sp. (smooth), Frondicularia brizaeformis Bornemann, Involutina liassica (Jones), Lenticulina varians (Bornemann), Lingulina cornua ssp.A, Marginulina prima incisa (Franke), M.prima praerugosa Norvang, M.prima rugosa Bornemann, Nodosaria metensis Terquem, Planularia inaequistriata, Pseudonodosaria vulgata (Bornemann), "Spiroloculina" sp.A Copestake and Johnson.

Comments
The presence of "Spiroloculina" sp.A and M.prima incisa indicates a bucklandi Zone age. "Spiroloculina" sp.A has not previously been recorded from Dorset but occurs commonly in the bucklandi Zone elsewhere in Britain.

OSTRACODA (IDB)
Bairdia gantoftensis Sivhed, B.molesta Apostolescu, Cardobairdia sp., Cytherelloidea circumscripta (Blake), ?Cytheropteron sp., Isobythocypris elongata (Blake), I. sp.1, Macrocypris sp.1,

Monoceratina frentzeni Triebel and Bartenstein, M. sp., Ogmoconcha hagenowi Drexler, Ogmoconcha sp., Ogmoconchella aspinata (Drexler), O.bispinosa (Grundel), O.nasuta (Drexler), O.teleata (Drexler), Polycope cerasia Blake, Stenestroemia roedbyensis? Michelsen.

Comments
Still within the range of O.spinata. S.roedbyensis was described from the Hettangian and Lower Sinemurian of Denmark by Michelsen (1970). In Dorset it has been recorded only in the bucklandi Zone. This assemblage is very similar to that of Drexler (1958) from Siebeldingen/Pfalz (Lias alpha, Hettangian), West Germany.

CALCAREOUS NANNOFOSSILS (PRB)
Crepidolithus pliensbachensis Crux, Crucirhabdus primulus Prins ex Rood et al., Mitrolithus elegans Deflandre, Parhabdolithus liasicus Deflandre, Parhabdolithus marthae Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood et al..

Comments
P.marthae has a resticted range in the Lower Sinemurian (bucklandi Zone to semicostatum Zone). The sample represents the earliest record of C.pliensbachensis (previously recorded from the semicostatum Zone).

PALYNOMORPHS (JBR)
Spores: Kraeuselisporites reissingeri (Harris) Morbey.
Pollen: Alisporites thomasii (Couper) Pocock, Cerebropollenites? (Potonie and Venitz) Nilsson sp., Chasmatosporites apertus (Rogalska) Nilsson, Circulina granulata Adloff et al., circumpolles indet., Perinopollenites elatoides Couper, Podocarpidites Cookson ex Couper sp..
Acritarchs: Micrhystridium lymensis var. lymensis Wall, M.lymensis var. gliscum Wall, Micrhystridium Deflandre sp..
Misc.: foraminiferal test lining.

Comments
K.reissingeri is a marker for the Rhaetian to early Sinemurian. P.elatoides ranges from the basal Jurassic, confirming the Hettangian/early Sinemurian age. The abundance of C.granulata is indicative of a relatively warm climate and the simple, spiny acritarch genus Micrhystridium suggests a quiet, nearshore environment. A relatively sparse palynoflora dominated by C.granulata and Alisporites spp.; low level of marine elements.

Sample D6 (Blue Lias, Lang Bed 50; semicostatum Zone, scipionanum Subzone) (SY33359150)

FORAMINIFERA (PC)
Ammodiscus siliceus (Terquem), Astacolus semireticulata (Fuchs), Dentalina torta, F. terquemi sulcata form F Barnard, Lenticulina varians (Bornemann), Marginulina prima incisa (Franke), Neobulimina sp.2 Bang, 1968, Planularia inaequistriata, Spirillina tenuissima (casts) or ?Cornuspira liasina microspheric forms).

Comments
Neobulimina sp.2 (angulata - early obtusum Zone), A.semireticulata (late semicostatum Zone - turneri Zone) and F.terquemi sulcata form F

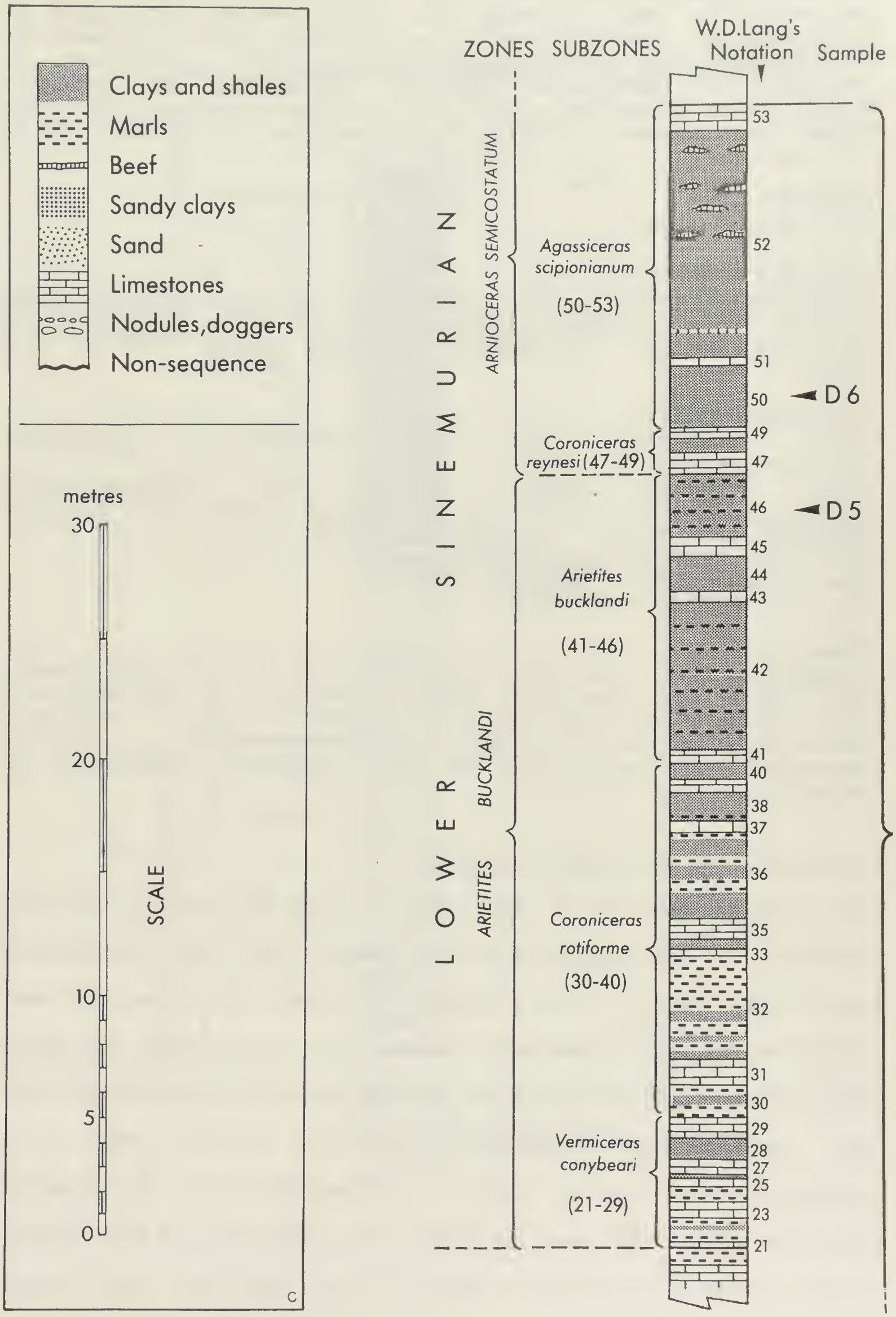


Fig. 2. Blue Lias (Lower Sinemurian part). Redrawn after Cope, Hallam and Torrens 1969.

(appears in abundance in the late semicostatum Zone in Britain) confirm the semicostatum Zone age of the sample. The latter two index species have not previously been recorded from Dorset, whilst this record of Neobulimina sp.2 confirms that of Norling (1972). The first appearances of A.semireticulata and F.terqeumi sulcata form F represent an important foraminiferal datum in the late semicostatum Zone throughout Britain. This assemblage occurs in the late semicostatum Zone - top turneri Zone elsewhere in Britain, and the position of the sample may be incorrect.

OSTRACODA (IDB)
No ostracods recovered.

CALCAREOUS NANNOFOSSILS (PRB)
Crucirhabdus primulus Prins ex Rood et al., Parhabdolithus liasicus Deflandre, Parhabdolithus marthae Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood et al..

PALYNOMORPHS (JBR)
Spores: Cyathidites minor Couper, Zebrasporites interscriptus (Thiergart) Klaus,
Pollen: Alisporites thomasii (Couper) Pocock, Cerebropollenites mesozoicus (Couper) Nilsson, Chasmatosporites Nilsson sp., Circulina granulata Adloff et al., Classopollis classoides Pflug.
Acritarchs: Micrhystridium Deflandre sp..
Prasinophycean algae: Tasmanites Newton sp..
Misc: foraminifera test lining.

Comments
C.mesozoicus ranges from the basal Sinemurian, the additional presence of Z.interscriptus (Rhaetian to lowermost Sinemurian) is indicative of a basal Sinemurian age. The dominance of circumpolles implies a relatively warm climate. The low level of marine palynomorphs suggests a nearshore environment. A sparse palynoflora with C.granulata dominating the assemblage.

Black Ven, west of Charmouth (SY357932)

The top of the Blue Lias is seen east of Lyme Regis and in Black Ven, succeeded by Shales with Beef (21m), Black Ven Marls (43m) and Belemnite Marls (23m). The cliff is very susceptible to land slips and most of these formations are more conveniently exmined east of Charmouth. The Shales with Beef were sampled under Black Ven and eastwards near the River Char. The term "Beef" refers to the layers of fibrous calcite formed during diagenesis and recently linked to overpressuring of the formation (Stoneley 1983). This and overlying units have up to 8% total organic carbon (Stoneley and Selley 1986) and are important source rocks.

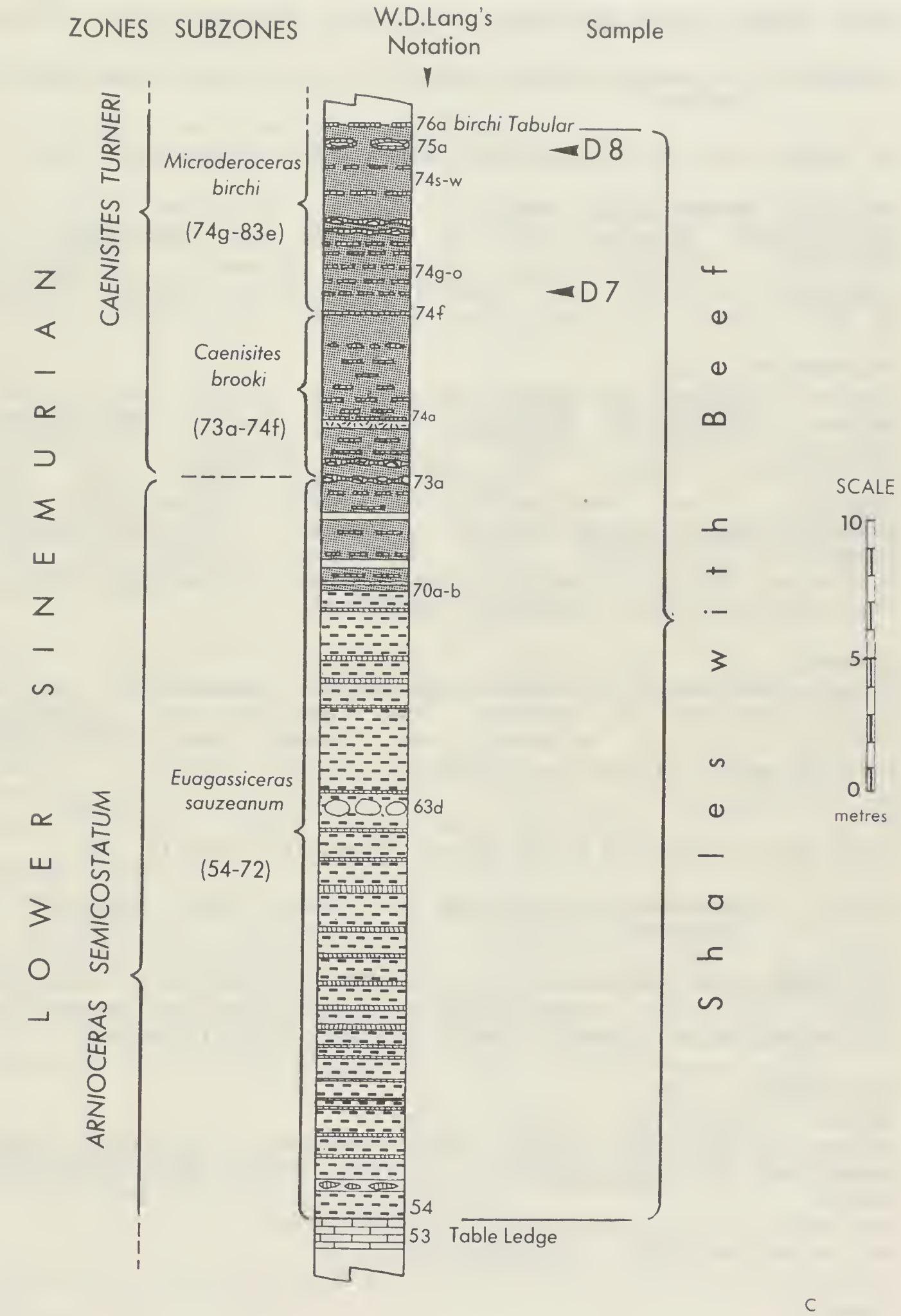


Fig. 3. Shales with Beef (Lower Sinemurian). (Redrawn after Wilson et al. 1958).

Deposition was under anoxic bottom conditions.

Cliff at east end of Black Ven:

Sample D7 (Shales with Beef, Lang Bed 74g; turnei Zone, basal birchi Subzone)

No FORAMINIFERA or OSTRACODA recovered - anoxic bottom conditions.

CALCAREOUS NANNOFOSSILS (PRB)
Crucirhabdus primulus Prins ex Rood et al., Mitrolithus elegans Deflandre, Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood et al..

PALYNOMORPHS (JBR)
Spores: Cyathidites minor Couper.
Pollen: Alisporites thomasii (Couper) Pocock, ?Cerebropollenites mesozoicus (Couper) Nilsson, Circulina granulata Adloff et al., circumpolles indet., Classopollis classoides Pflug, Corollina meyeriana (Klaus) Venkatachala and Goczan, Eucommiidites troedssoni Erdtman, Podocarpidites Cookson ex Couper sp., trisaccate pollen grain indet..
Acritarchs: Micrhystridium stellatum Deflandre, M. Deflandre 1937 sp..
Prasinophycean algae: Tasmanites Newton sp..

Comments
Large proportions of circumpolles pollen is characteristic of the early Lower Jurassic in Britain. The abundance of C.granulata is indicative of a relatively warm climate. There is a relatively low level of marine palynofloral elements.

Cliff west of Heritage Coast Centre, below birchi Nodular Bed

Sample D8 (Shales with Beef, Lang Bed 74w; turneri Zone, mid birchi Subzone)

No FORAMINIFERA, OSTRACODA or CALCAREOUS NANNOFOSSILS recovered. The absence of benthic organisms may be due to anoxic bottom conditions but the absence of calcareous plankton indicates decalcification.

PALYNOMORPHS (JBR)
Spores: Cyathidites minor Couper.
Pollen: Alisporites thomasii (Couper) Pocock, Circulina granulata Adloff et al., Classopollis classoides Pflug, bisaccate pollen grain indet.
Acritarchs: Micrhystridium stellatum Deflandre.
Prasinophycean algae: Tasmanites Newton sp..

Comments
As for D7

Stonebarrow to Ridge Waterfall, east of Charmouth (SY370929 - SY390924)

Successively dipping down to beach level, the Black Ven Marls (Upper Sinemurian), Belemnite Marls and Green Ammonite Beds (Lower Pliensbachian) can be conveniently examined along the shore.

Sample D9a (Black Ven Marls, Lang Bed 79; turneri Zone, high in the birchi Subzone).

FORAMINIFERA (PC)
Ammodiscus siliceus (Terquem), Marginulina prima incisa (Franke),

Comments
The impoverished nature of the assemblage and abundance of the agglutinated species A.siliceus is indicative of probable dysaerobic conditions.

OSTRACODA (IDB)
Monoceratina fusiformis (Drexler), Paratrachycythere pseudotubulosa Park MS, Patellacythere gruendeli Herrig, ?Progonoidea reticulata (Klingier and Neuweiler), Gen et sp.1

Comments
P.gruendeli (bucklandi Zone - turneri Zone) and P.pseudotubulosa (turneri Zone - obtusum Zone) confirm the turneri Zone age of this sample.

CALCAREOUS NANNOFOSSILS (PRB)
Crucirhabdus primulus Prins ex Rood et al., Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood et al..

PALYNOMORPHS (JBR)
Spores: Acanthotriletes Naumova sp., Todisporites minor Couper.
Pollen: Alisporites Daugherty sp., A.thomasii (Couper) Pocock, Cerebropollenites mesozoicus (Couper) Nilsson, Circulina granulata Adloff et al., Classopollis classoides Pflug, Eucommiidites troedssoni Erdtman, Perinopollenites elatoides Couper.
Acritarchs: Micrhystridium lymensis var. gliscum Wall, M. cf. M.stellatum Deflandre, Micrhystridium Deflandre sp., acritarch indet..

Comments
C.mesozoicus and T.minor are indicative of a Jurassic (post-basal Sinemurian age). Environment as for D5. The assemblage is relatively well-preserved and dominated by C.classoides.

SAMPLE D9b (Black Ven Marls, Lang Bed 86?; obtusum Zone, stellare subzone)

FORAMINIFERA (PC)
Lenticulina muensteri var. matutina (d'Orbigny).

Comments
The first appearance of the large individuals of L.meunsteri (including

the uncoiled variant matutina) occurs in the obtusum Zone throughout Britain.

OSTRACODA (IDB)
Ektyphocythere intermedia? (Gramann).

Comments
Foraminifera and ostracoda poor - marine, ?nearshore.

CALCAREOUS NANNOFOSSILS (PRB)
Crucirhabdus primulus Prins ex Rood et al., Mitrolithus elegans Deflandre, Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood et al..

PALYNOMORPHS (JBR)
Spores: Cyathidites minor Couper, Osmundacidites wellmannii Couper.
Pollen: Alisporites Daugherty sp., Cerebropollenites mesozoicus (Couper) Nilsson, Classopollis classoides Pflug, bisaccate pollen indet., Vitreosporites pallidus (Reissinger) Nilsson.
Prasinophycean algae: Tasmanites newtoni Wall, T. Newton sp..

Comments
Sporomorph assemblage indicative of a broad Lower/Middle Jurassic age. The abundance of C.classoides indicates relatively warm conditions, and the presence of relatively high numbers of Tasmanites infers a nearshore environment. A sparse assemblage dominated by C.classoides with rare but relatively diverse Tasmanites.

Sample D9c (Black Ven Marls, Lang Bed 90; raricostatum Zone, densinodulum Subzone).

FORAMINIFERA (PC)
Merginulina prima spinata d'Orbigny.

Comments
The first appearance of M.prima spinata is diagnostic of the latest Sinemurian (raricostatum Zone) in N.W.Europe. This record is slightly early for Britain, its previous reported first appearance being from the raricostatum Subzone (Copestake and Johnson, 1981).

OSTRACODA (IDB)
No ostracods recovered.

CALCAREOUS NANNOFOSSILS (PRB)
Crucirhabdus primulus Prins ex Rood et al., Mitrolithus elegans Deflandre, Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood et al..

PALYNOMORPHS (JBR)
Spores: Cyathidites minor Couper, Kraeuselisporites reissingeri (Harris) Morbey, Retitriletes semimuris (Danze-Corsin and Laveine) MacKellar.
Pollen: Alisporites Daugherty sp., Cerebropollenites mesozoicus (Couper) Nilsson, Chasmatosporites hians Nilsson, Classopollis classoides Pflug, Eucommiidites troedssonnii Erdtman, Perinopollenites

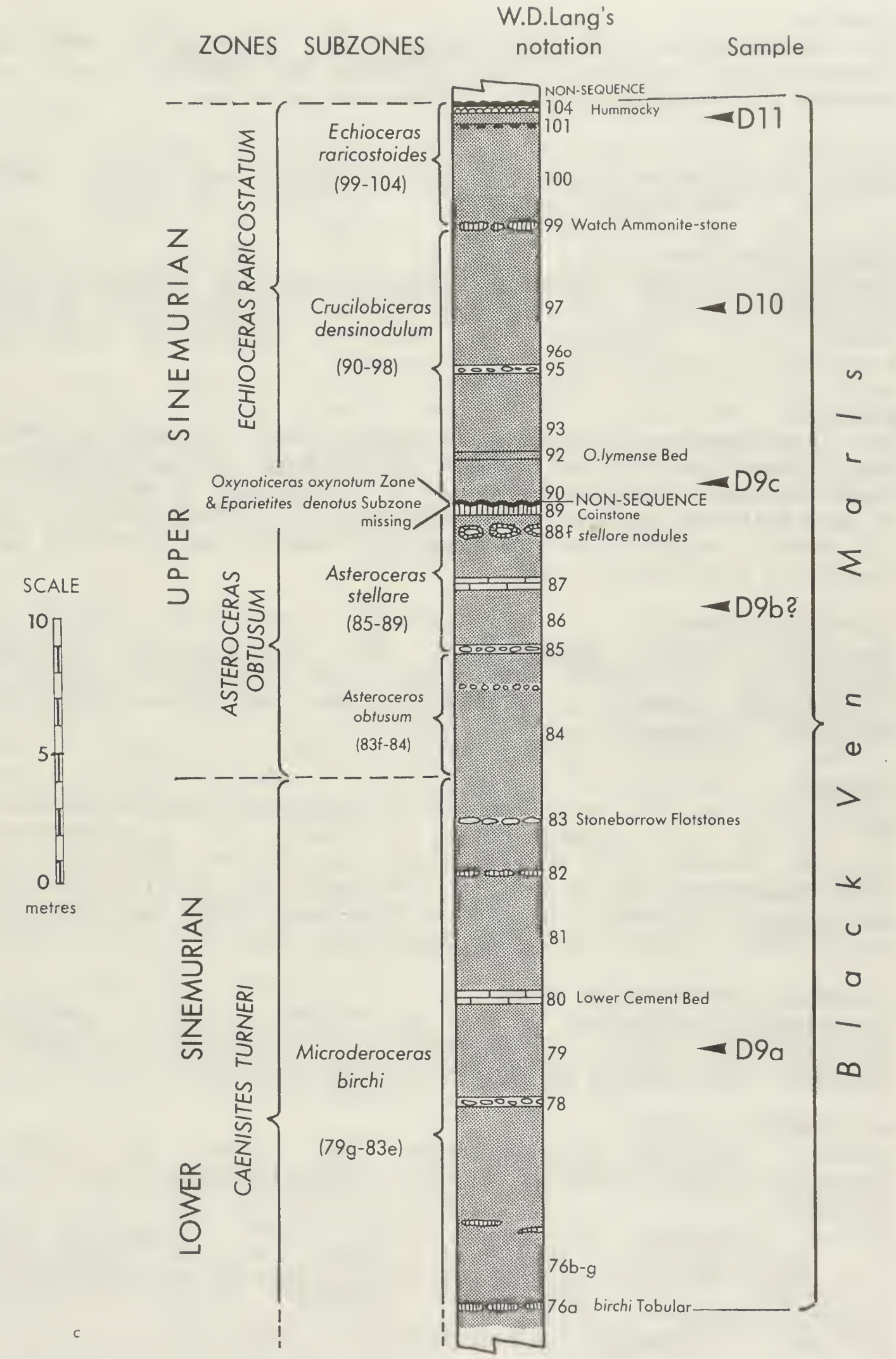


Fig. 4. Black Ven Marls (Lower-Upper Sinemurian). (Redrawn after Wilson et al. 1958.

elatoides Couper, Vitreosporites pallidus (Reissinger) Nilsson.
Prasinophycean algae: Tasmanites Newton sp..

Comments
The co-occurrence of K.reissingeri and R.semimuris indicates a Sinemurian age. Abundant Classopollis infers an equable climate and the presence of Tasmanites suggests a nearshore situation.

Sample D10 (Black Ven Marls, Lang Bed 97; raricostatum Zone, high in the densinodulum Subzone).

FORAMINIFERA (PC)
Ammodiscus siliceus (Terquem), Dentalina matutina d'Orbigny, D.torta, F.terquemi bicostata d'Orbigny, Lenticulina muensteri s.s., L.muensteri nodose var., L.muensteri var. matutina, Marginulina prima spinata d'Orbigny, Planularia protracta (Bornemann).

Comments
The first occurrence of abundant L.muensteri is characteristic of the late Sinemurian (obtusum - raricostatum Zones) throughout Britain. The sharp increase in uncoiled variants of L.muensteri is notable and occurs at many different horizons within the Jurassic. It appears to be part of the normal variation within muensteri populations and thus warrants subspecies classification only.

OSTRACODA (IDB)
Macrocypris sp.1, Ogmoconchella cf. O.adenticulata (Pietrzenuk), O.bispinosa (Grundel), Paracypris sp.2, Polycope cerasia Blake, P.cincinnata Apostolescu, P.plumhoffi Bate and Coleman, P. sp. 4044 Michelsen, Spinocypris sp..

Comments
Spinocypris sp. is only recorded in Dorset from the raricostatum Zone. The species O. cf. O.adenticulata is similar to "O.mouhersensis" of authors - Grundel 1970, Michelsen 1975 (part),Sivhed 1980 (part) and Park 1985. However, it has a distinct fingerprint sculpture and lacks the well-defined vertical rib of the type description (Apostolescu 1959). Herrig (1969, p.1074) records O.adenticulata from the bucklandi Zone.

CALCAREOUS NANNOFOSSILS (PRB)
Crucirhabdus primulus Prins ex Rood et al., Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood et al..

PALYNOMORPHS (JBR)
Spores: Acanthotriletes (Naumova) ex Potonie and Kremp sp., Auritulinasporites scanicus Nilsson, Concavissimisporites Delcourt and Sprumont.
Pollen: Alisporites microsaccus (Couper) Pocock, Alisporites Daugherty sp., Cerebropollenites mesozoicus (Couper) Nilsson, Chasmatosporites cf. H.hians Nilsson, Classopollis classoides Pflug, Perinopollenites elatoides Couper.
Acritarchs: ?Leiosphaeridia Eisenack.

Comments
Sporomorph assemblage indicates a broad Lower/Middle Jurassic age but the absence of Callialasporites spp. suggests a Sinemurian - Lower Toarcian

age is most likely. Poorly preserved, sparse assemblage dominated by C.classoides (indicates warm environment) with extremely rare marine elements.

Sample D11 (Black Ven Marls, Lang Bed 102; raricostatum Zone, raricostoides Subzone).

FORAMINIFERA (PC)
Ammodiscus siliceus (Terquem), Annulina metensis Terquem, Dentalina arbuscula, Dentalina matutina, D.pseudocommunis, Dentalina varians varians, Eoguttulina liassica, F.terquemi sulcata Form E Barnard, F.terquemi sulcata form F Barnard, Glomospirella sp.nov., Lenticulina muensteri s.s., L.muensteri var. matutina, Lingulina tenera tenera, Marginulina prima prima d'Orbigny, Nodosaria metensis, N.mitis (Terquem and Berthelin).

Comments
Typical Late Sinemurian assemblage. A.metensis is an agglutinated corpuscular disc described from the Rhaetian of W.Germany (Will 1969) and the Lower Jurassic of France (Terquem 1862, 1883) and Germany (Franke 1936). This is its first record from the U.K.. According to Loeblich and Tappan (1964) this species is either a radiolarian or an echinoderm spicule. The Dorset material is clearly agglutinating and therefore a probable foraminifera of an undescribed genus.

OSTRACODA (IDB)
Bardia? molesta Apostolescu, Cardobairdia sp., Gramannicythere cf. G.coniuncta Herrig, Gen. et sp.2, Isobythocypris elongata Blake, I. sp.2, Kinkelinella variabilis (Klingler and Neuweiler), Monoceratina amlingstadtensis Tribel and Bartenstein, Ogmoconchella cf. O.adventiculata (Pietrzenuk), O.bispinosa (Grundel), O.danica Michelsen, Paracypris sp.2, Patellacythere gruendeli Herrig, Polycope cerasia Blake, P.cincinnata Apostolescu, P.decorata Apostolescu, Spinocypris sp..

Comments
Age determination, as for D10. This is the oldest range recorded for M.amlingstadtensis, and the youngest range recorded for P.gruendeli (in Dorset).

CALCAREOUS NANNOFOSSILS (PRB)
Crepidolithus crassus (Deflandre) Noel, C.pliensbachensis Crux, Crucirhabdus primulus Prins ex Rood et al., Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood et al..

Comments
The appearance of C.crassus (oxynotum Zone - ?Upper Jurassic) completes the typical early Lower Jurassic assemblage.

PALYNOMORPHS (JBR)
Spores: Retitriletes? (Pierce) Doring et al. sp. Pollen: Alisporites microsaccus (Couper) Pocock, Alisporites Daugherty spp., Cerebropollenites mesozoicus (Couper) Nilsson, Classopollis classoides Pflug, Perinopollenites elatoides Couper.

The Belemnite Marls (Lower Pliensbachian) can be sampled east of Westhay Water (SY 38609250).

Sample D12 (Belemnite Marls, Lang Bed 110a - 2.5m below top; jamesoni Zone, polymorphus Subzone).

FORAMINIFERA (PC)
Bathysiphon sp., Lenticulina muensteri s.s., Marginulina prima rugosa.

OSTRACODA (IDB)
Acrocythere herrigi Park MS., Gramannicythere bachi bachi Herrig, Ogmoconchella sp.1, Ostracod no.19 Klingler (pl.13, fig.22), Paradoxostoma pusillum Michelsen, Pleurifera vermiculata (Apostolescu).

Comments
The presence of P.vermiculata indicates a jamesoni - lowest ibex Zone age (Park, 1985). Ostracod No.19 Klinger is identical to topotype material of Ostracode E Apostolescu (1959). Park (1985) recorded this species as Kinkelinella (Ektyphocythere) foveolata Michelsen. It is obviously ancestral to Gammacythere ubiquita Malz and Lord.

CALCAREOUS NANNOFOSSILS (PRB)
Crepidolithus crassus (Deflandre) Noel, C.pliensbachensis Crux, Crucirhabdus primulus Prins ex Rood et al., Mitrolithus elegans Deflandre, Orthogonoides hamiltoniae Wiegand, Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood et al..

Comments
O.hamiltoniae ranges from oxynotum Zone to falciferum Zone in N.W.Europe.

PALYNOMORPHS (JBR)
Spores: Cythadites australis Couper, C.minor Couper, C. cf. C.concavus (Bolkhoritina) Dettmann, Dictyophyllidites Couper sp..
Pollen: Alisporites Daugherty sp., Cerebropollenites mesozoicus (Couper) Nilsson, Classopollis classoides Pflug, Chasmatosporites Nilsson sp., Corollina meyeriana (Klaus) Venkatachala and Goczan, Cycadopites cf. C.nitidus (Balme) Pocock, Podocarpidites Cookson ex Couper sp., Vitreosporites pallidus (Reissinger) Nilsson.
Acritarchs: Micrhystridium lymensis var. rigidum Wall, Micrhystridium Deflandre sp..
Prasinophycean algae: Tasmanites Newton sp..

Comments
A poorly preserved assemblage, dominated by gymnosperm pollen with rare marine elements. The presence of C.mesozoicus (Sinemurian or younger) and absence of Callialasporites and Nannoceratopsis (dinoflagellate cyst) indicates a Sinemurian/early Pliensbachian age. Assemblage is representative of a near shore environment with an equable climate.

Sample D13 (Belemnite Marls, Lang Bed 118a - 3.6m below Belemnite Stone; jamesoni Zone, jamesoni Subzone).

FORAMINIFERA (PC)
Dentalina terquemi, F.terquemi sulcata form F Barnard (but up to 7 ribs not 6), Lenticulina acutiangulata (Terquem), L.muensteri muensteri, L.muensteri var. matutina, L. muensteri "Darbyella form" (trochospirally coiled), Marginulina prima interrupta, M.prima prima, M.prima spinata, Planularia eugenii (Terquem), P.protracta.

Comments
This representative early Pliensbachian assemblage is largely a continuation of the late Sinemurian fauna but lacks such species as D.matutina which becomes reduced in numbers at the top of the Sinemurian. First appearance of well developed L.muensteri acutiangulata with bosses and keels more typical of later Jurassic forms. Earlier types of L.muensteri all lack bosses.

OSTRACODA (IDB)
Acrocythere herrigi Park MS., Gramannicythere bachi bachi Herrig, Monoceratina amlingstadtensis Triebel and Bartenstein, M.seebergensis Triebel and Bartenstein, Ogmoconchella bispinosa (Grundel), Ostracod no.19 Klingler, Paracypris sp.1, Paradoxostoma pusillum Michelsen, Polycope cerasia Blake, P.cincinnata Apostolescu, P.plumhoffi Bate and Coleman, P. sp..

Comments
See D12

CALCAREOUS NANNOFOSSILS (PRB)
Biscutum novum (Goy) Bown, Calyculus sp., Chiastozygus primitus Prins ex Rood et al., Crepidolithus crassus (Deflandre) Noel, Mitrolithus elegans Deflandre, Orthogonoides hamiltoniae Wiegand, Parhabdolithus liasicus Deflandre, P.robustus Noel, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood et al..

Comments
The first appearance of B.novum is an important biohorizon recorded in the jamesoni Zone of N.W.Europe. P.robustus is also found relatively abundantly in the jamesoni Zone only but ranges from turneri Zone to ibex Zone. Calyculus sp. has previously been recorded from the ibex Zone in N.W.Europe.

PALYNOMORPHS (JBR)
Spores: Cyathidites minor Couper, Retitriletes semimurus (Danze-Corsin and Laveine) MacKellar.
Pollen: Alisporites Daugherty sp., Cerebropollenites mesozoicus (Couper) Nilsson, Chasmatosporites apertus (Rogalska) Nilsson, C. Nilsson sp., circumpolles indet., Classopollis classoides Pflug, Cycadopites nitidus (Balme) Pocock, Perinopollenites elatoides Couper.
Prasinophycean algae: Tasmanites Newton sp..

Comments
A sparse, poorly preserved palynoflora dominated by C.classoides and C.mesozoicus with rare marine elements. Age and environment as D12.

Sample D14 (Belemnite Marls, Lang Bed 119 - 1.5m below Belemnite Stone; ibex Zone, valdani Subzone).

FORAMINIFERA (PC)
Ammodiscus siliceus (Terquem), Dentalina pseudocommunis, D.subsiliqua, D.terquemi Franke, L.muensteri muensteri, L.muensteri ssp.A, L.muensteri var. matutina (uncoiled), L.varians, Lingulina lanceolata (Haeusler), Marginulina prima prima/spinata intermediates, M.prima spinata, M.prima spinata/interrupta Terqeum intermediates, Nodosaria sexcostata Terquem, Ophthalmidium macfadyeni Wood and Barnard.

Comments
The abundance of M.prima spinata is diagnostic of well-oxygenated shelf environments in the Pliensbachian. L.muensteri ssp.A is a form distinguished by the presence of nodes. It is regarded as a chrono-subspecies because of its restricted range in the British early Pliensbachian.

OSTRACODA (IDB)
Acrocythere herrigi Park MS., Ektyphocythere foveolata Michelsen, Gramannicythere bachi bachi Herrig, Liasina lanceolata (Apostolescu), Monoceratina amlingstadtensis Triebel and Bartenstein, M.frentzeni Triebel and Bartenstein, M.multistriata Triebel and Bartenstein, Ogmoconchella bispinosa (Grundel), O. cf. O.pseudospina (Herrig), Pleurifera vermiculata Apostolescu, Polycope cincinnata Apostolescu, P.plumhoffi Bate and Coleman, P. sp..

Comments
As D12.

CALCAREOUS NANNOFOSSILS (PRB)
Biscutum novum (Goy) Bown, Calyculus sp., Chiastozygus primitus Prins ex Rood et al., Crepidolithus crassus (Deflandre) Noel, Crucirhabdus primulus Prins ex Rood et al., Parhabdolithus liasicus Deflandre, P.robustus Noel, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood et al..

PALYNOMORPHS (JBR)
Spores: Baculatisporites Thompson and Pflug sp., Cyathidites minor Couper, Retitriletes austroclavatidites (Cookson) Schulz et al..
Pollen: Alisporites Daugherty spp., Cerebropollenites mesozoicus (Couper) Nilsson, Chasmatosporites apertus (Rogalska) Nilsson, Classopollis classoides Pflug, Podocarpidites Cookson ex Couper sp., Vitreosporites pallidus (Reissinger) Nilsson.
Acritarchs: Micrhystridium lymensis var. rigidum Wall, Micrhystridium Deflandre sp.

Comments
As D12.

Golden Cap, west of Seatown (SY 406920)

The base of the Green Ammonite Beds (32m) can be seen at the foot of the cliff on both east and west sides of Golden Cap, although a minor syncline

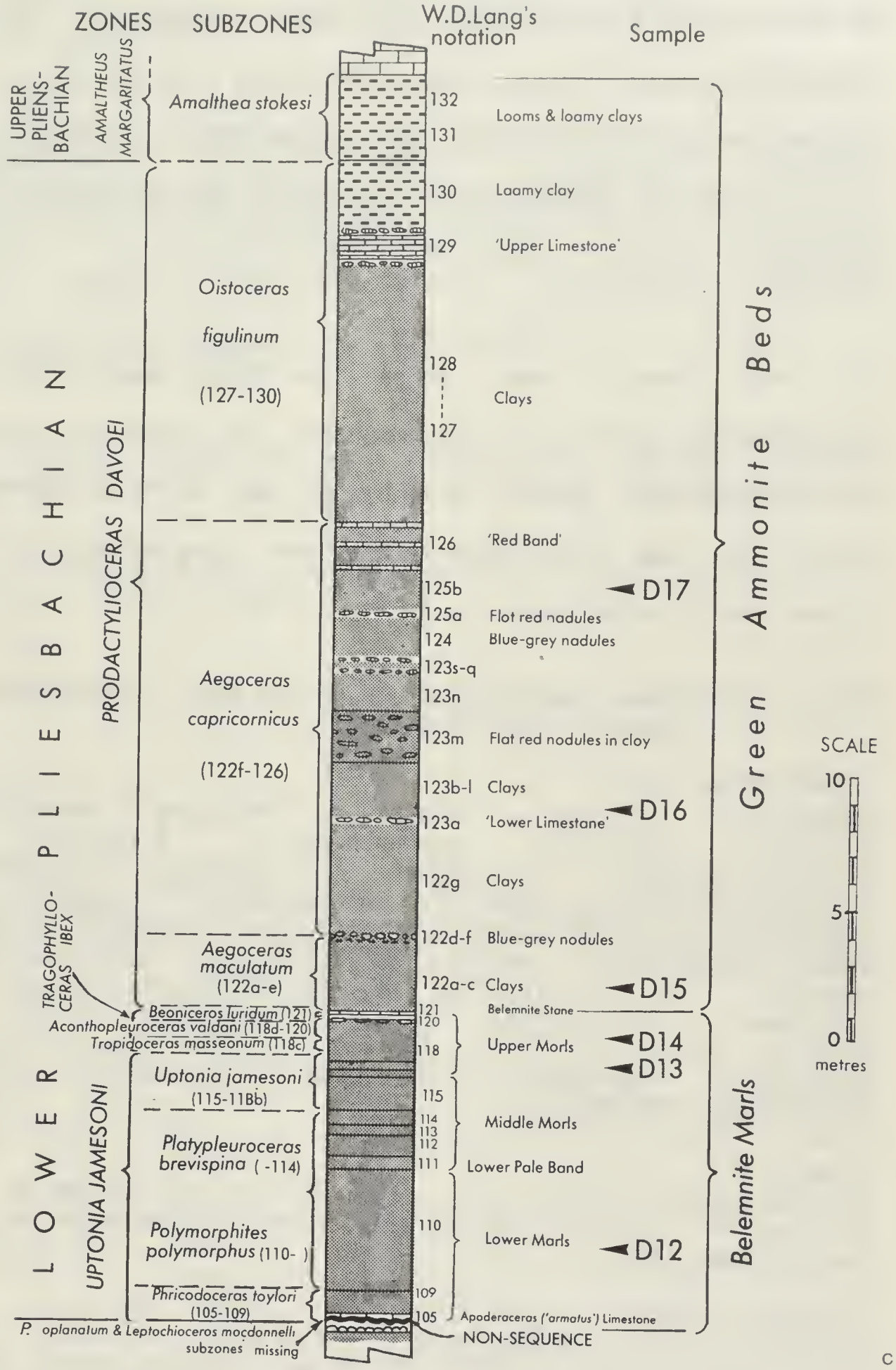


Fig. 5. Belemnite Marls and Green Ammonite Beds (Lower Pliensbachian). (Redrawn after Wilson et al. 1958).

beneath the hill depresses the junction with the Belemnite Marls (marked by the Belemnite Stone) below beach level. Higher in the cliff Upper Plinsbachian Eype Clay and Down Cliff Sands crop out but are more readily examined in Down Cliff to the east. Golden Cap is the highest cliff on the Dorset coast and derives its name from the yellow Albian sands at its summit.

The Green Ammonite Beds, which take their name from green calcite occassionally found infilling ammonites, are dominantly argillaceous with minor limestones. Benthic assemblages may be poor due to bottom water anoxia. The lower Green Ammonite Beds were sampled east of Golden Cap and higher levels below the hill.

Sample D15 (Green Ammonite Beds, Lang Bed 122b; davoei Zone, maculatum Subzone). (SY 41309190).

FORAMINIFERA (PC)
Ammodiscus siliceus (Terquem), "Annulina" metensis, Astacolus scalptus, Dentalina pseudocommunis, D.terquemi, F.terquemi bicostata/terquemi intermediate, F.terquemi sulcata form E, F.terquemi sulcata form F/G intermediate, F.terquemi sulcata form H, Involutina liassica (Jones), Lenticulina muensteri matutina (uncoiled var.), L.muensteri muensteri, L.varians (Bornemann) (s.s. and uncoiled var.), Lingulina tenera tenuistriata/pupa intermediate (Terquem), Marginulina prima interrupta Terquem (aberrant form with no "roof" on final chamber), M.prima prima, M.prima spinata, Nodosaria fontinensis (corroded specimen), Pseudonodosaria multicostata Bornemann.

Comments
The reappearance of I.liassica represents a second acme of this species observed in southern England; the earlier abundance peak occurs in the Lower Sinemurian.

OSTRACODA (IDB)
Cardobardia sp., Gammacythere ubiquita Malz and Lord, Isobythocypris sp.2, Monoceratina sp.4135 Michelsen, Ogmoconchella cf. O.aequalis (Herrig), O.amalthei Form A Michelsen, O. cf. O.pseudospina (Herrig), Polycope cerasia Blake, P.cincinnata Apostolescu, P.decorata Apostolescu, P.discus Fischer, P.plumhoffi Bate and Coleman.

Comments
G.ubiquita indicates an upper ibex Zone - davoei Zone age.

CALCAREOUS NANNOFOSSILS (PRB)
Biscutum novum (Goy) Bown, Crepidolithus crassus (Deflandre)

Mitrolithus elegans Deflandre, Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood et al..

PALYNOMORPHS (JBR)
Spores: Cyathidites concavus (Bolkhovitina) Dettmann, C.minor Couper, Osmundacidites wellmanii Couper, Todisporites granulatus Traulan, Retitriletes austroclavatidites (Cookson) Schulz et al..
Pollen: Alisporites cf. A.microsaccus (Couper) Pocock, Alisporites Daugherty spp., Cerebropollenites mesozoicus (Couper) Nilsson, Chasmatosporites apertus (Rogalska) Nilsson, Classopollis classoides Pflug.
Acritarchs: Micrhystridium lymensis var. gliscum Wall.
Misc.: foraminiferal test lining.

Comments
A relatively sparse palynoflora with terrestrially derived elements dominating (gymnosperm pollen most abundant) and marine elements rare.

Sample 16 (Green Ammonite Beds, Lang Bed 123c; davoei Zone, capricornus Subzone). (SY 40409190).

FORAMINIFERA (PC)
Lenticulina muensteri uncoiled var., Planularia protracta group (Bornemann).

OSTRACODA (IDB)
Gammacythere ubiquita Malz and Lord.

CALCAREOUS NANNOFOSSILS (PRB)
Crepidolithus crassus (Deflandre) Noel, Mitrolithus elegans Deflandre, Parhabdolithus liasicus Deflandre, Parhabdolithus robustus Noel, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood, Hay and Barnard.

PALYNOMORPHS (JBR)
Spores: Concavisporites toralis (Leschik) Nilsson, Cyathidites australis Couper, C.minor Couper, Densoisporites Weyland and Krieger, sp., Leptolepidites Couper, sp., Osmundacidites wellmanii Couper, Retitriletes austroclavatidites (Cookson) Schulz et al., Retitriletes (Pierce) Doring et al. sp., Retitriletes semimuris (Danze-Corsin and Laveine) MacKellar.
Pollen: Alisporites Daugherty sp., Cerebropollenites mesozoicus (Couper) Nilsson, Chasmatosporites apertus (Rogalska) Nilsson, Classopollis classoides Pflug, Perinopollenites elatoides Couper, Podocarpidites Cookson ex Couper sp., Vitreosporites pallidus (Reissinger) Nilsson. Acritarchs: Micrhystridium lymensis var. gliscum Wall, Micrhystridium Deflandre sp..
Prasinophyceaen algae: Tasmanites Newton sp..
Misc.: Botryococcus Kutzing sp..

Comments
A relatively diverse, well-preserved assemblage dominated by bisaccate pollen (Alisporites spp.). The presence of the freshwater algae Botryococcus suggests a freshwater input nearby.

Sample D17 (Green Ammonite Beds, Lang Bed 125b; davoei Zone, capricornus Subzone). (SY 40259200)

FORAMINIFERA (PC)
Ammodiscus siliceus (Terquem), Cornuspira liasina, Dentalina pseudocommunis, D.varians varians, D. spp. (smooth), Eoguttulina liassica, Frondicularia squamosa Terquem and Berthelin, Lenticulina muensteri s.s., L.muensteri (uncoiled var.), Lingulina tenera pupa, Marginulina prima spinata, Planularia protracta group.

OSTRACODA (IDB)
Monoceratina amlingstadtensis Triebel and Bartenstein, Ogmoconchella sp.1, Polycope cincinnata Apostolescu, P.plumhoffi Bate and Coleman, P. sp..

CALCAREOUS NANNOFOSSILS (PRB)
Biscutum novum (Goy) Bown, Calyculus sp., Chiastozygus primitus Prins ex Rood et al., Crepidolithus crassus (Deflandre) Noel, Crucirhabdus primulus Prins ex Rood et al., Mitrolithus elegans Deflandre, Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood et al..

PALYNOMORPHS (JBR)
Spores: Baculatisporites Thompson and Pflug sp., Concavisporites Pflug sp., Corrugatisporites amplectiformis (Kara-Murza) Pocock, Cyathidites minor Couper, Densoisporites Weyland and Krieger sp., Leptolepidites? Couper sp., Osmundacidites wellmanii Couper, Retitriletes austroclavatidites (Cookson) Schulz et al., spore indet., Todisporites minor Couper.
Pollen: Alisporites Daugherty sp., Cerebropollenites mesozoicus (Couper) Nilsson, Chasmatosporites apertus (Rogalska) Nilsson, Classopollis classoides Pflug, Perinopollenites elatoides Couper, Podocarpidites Cookson ex Couper sp..
Acritarchs: Micrhystridium cf. fragile Deflandre, Micrhystridium lymensis var. gliscum Wall, Micrhystridium recurvatum Valens.
Prasinophycean algae: Tasmanites Newton sp..
Misc.: Botryococcus Kutzing sp., foraminiferal test lining.

The junction of the Lower and Upper Pliensbachian falls in the uppermost part of the Green Ammonite Beds and does not coincide with the base of the overlying Eype Clay, taken at the top of three prominent limestones called the Three Tiers (= base Middle Lias of British usage). The basal Eype Clay was sampled on the east flank of Golden Cap.

Sample D18 (Eype Clay, 1.5m above Upper Tier; margaritatus Zone, stokesi Subzone). (SY 40659190)

FORAMINIFERA (PC)
Marginulina prima spinata.

OSTRACODA (IDB)
Gramannella apostolescui Lord, Ogmoconcha transversa (Grundel), Ogmoconchella bispinosa (Grundel), ?Paracypris redcarensis Blake, Wicherella semiora semiora Lord.

Comments
G.apostolescui and W.semiora semiora indicate a stokesi Subzone to lowest subnodus Subzone age in Dorset (Lord, 1972).

CALCAREOUS NANNOFOSSILS (PRB)
Crepidolithus crassus (Deflandre) Noel, Schizosphaerella punctulata Deflandre and Dangeard.

Comments
Only two solution resistant forms have survived diagenetic destruction in this impoverished assemblage.

PALYNOMORPHS (JBR)
Spores: Cyathidites australis Couper, C.minor Couper, Leptolepidites Couper sp., Osmundacidites wellmanii Couper, Retitriletes austroclavatidites (Cookson) Schulz et al., R.semimuris (Danze-Corsin and Laveine) MacKellar, spore indet..
Pollen: Alisporites Daugherty sp., Cerebropollenites mesozoicus (Couper) Nilsson, Chasmatosporites apertus (Rogalska) Nilsson, Classopollis classoides Pflug, Perinopollenites elatoides Couper, Podocarpidites Cookson ex Couper sp., Vitreosporites pallidus (Reissinger) Nilsson.
Acritarchs: Baltisphaeridium inflatum var. inflatum Wall, Micrhystridium fragile Deflandre, M.lymensis var. rigidum Wall, Micrhystridium Deflandre sp..
Prasinophyceae algae: Tasmanites newtoni Wall, Tasmanites Newton sp..
Misc.: Botryococcus Kutzing sp..

Comments
A relatively diverse and well-preserved assemblage dominated by bisaccate pollen with rare marine components. Botryococcus suggests a nearby source of freshwater. The presence of B.inflatum var. inflatum indicates an Upper Pliensbachian age

Down Cliff and Thorncombe Beacon, east of Seatown (SY 420917-SY 437914)

The Eype Clay (60m) is a calcareous clay containing a prominent nodule band, the Eype Nodule Bed, at approximately 40m above the base. A fault brings the Eype Nodule Bed to beach level immediately east of Seatown where it forms a good marker horizon.

SAMPLE D19 (Eype Clay, 1.7m above Eype Nodule Bed; margaritatus Zone, stokesi Subzone).

FORAMINIFERA (PC)
Ammodiscus siliceus (Terquem), F.terquemi sulcata form E (convergent ribs), F.terquemi sulcata form F (7 ribs), F.terquemi/form F intermediate (5/6 faint striae), Lenticulina muensteri muensteri (no

boss), L.muensteri muensteri (uncoiled var.), Marginulina prima prima, M.prima spinata.

OSTRACODA (IDB)
Cytherella sp., gen. et sp.4, Gramannella apostolescui Lord, Liasina lanceolata (Apostolescu), Monoceratina michelseni Riegraf, Ogmoconcha transversa (Grundel), Ogmoconchella bispinosa (Grundel), Ogmoconchella cf. O.pseudospina (Herrig), Polycope cerasia Blake, Wicherella semiora semiora Lord.

Comments
Type locality for Gramannella and Whicherella.

CALCAREOUS NANNOFOSSILS (PRB)
Crepidolithus crassus (Deflandre) Noel, Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard,

PALYNOMORPHS (JBR)
Spores: Cyathidites australis Couper, C.minor Couper, Dictyophyllidites mortoni (De Jersey) Playford and Dettmann, Leptolepidites equatibossus (Couper) Tralau, Lycopodiacidites cerniidites (Ross) Brenner, Lycopodiacidites Couper sp., Osmundacidites wellmanii Couper, Retitriletes clavatoides (Couper) Schulz, Retitriletes (Pierce) Doring et al., Todisporites minor Couper.
Pollen: Alisporites microsaccus (Couper) Pocock, A.rotundus Rouse, A.thomasii (Couper) Pocock, Cerebropollenites mesozoicus (Couper) Nilsson, Chasmatosporites Nilsson sp., Classopollis classoides Pflug, Perinopollenites elatoides Couper, Podocarpidites Cookson ex Couper sp..
Acritarchs: Micrhystridium recurvatum Valensi.
Prasinophycean algae: Tasmanites Newton sp..
Misc.: Botryococcus Kutzing sp.

The top of the Eype Clay is marked by the Starfish Bed, which is succeeded by the Down Cliff Sands (27m), all of which belong to the stokesi Subzone. The Margaritatus Stone and Clay (3m) and Thorncombe Sands (23m) belong to the subnodus Subzone. The Margaritatus Clay was sampled on the west side of Thorncombe Beacon.

Sample D20 (Margaritatus Clay; margaritatus Zone, subnodus Subzone).

FORAMINIFERA (PC)
Astacolus speciosus (Terquem), Dentalina matutina, D.terquemi, F.terquemi bicostata, F.terquemi sulcata form F (7 ribs), F.terquemi terquemi, F.terquemi ssp.B/form E intermediate (lateral ribs disappearing, ribs slightly convergent), Lenticulina muensteri acutiangulata, L.muensteri (uncoiled var.), Lingulina tenera pupa, Marginulina prima spinata (aberrant form), Pseudonodosaria vulgata group.

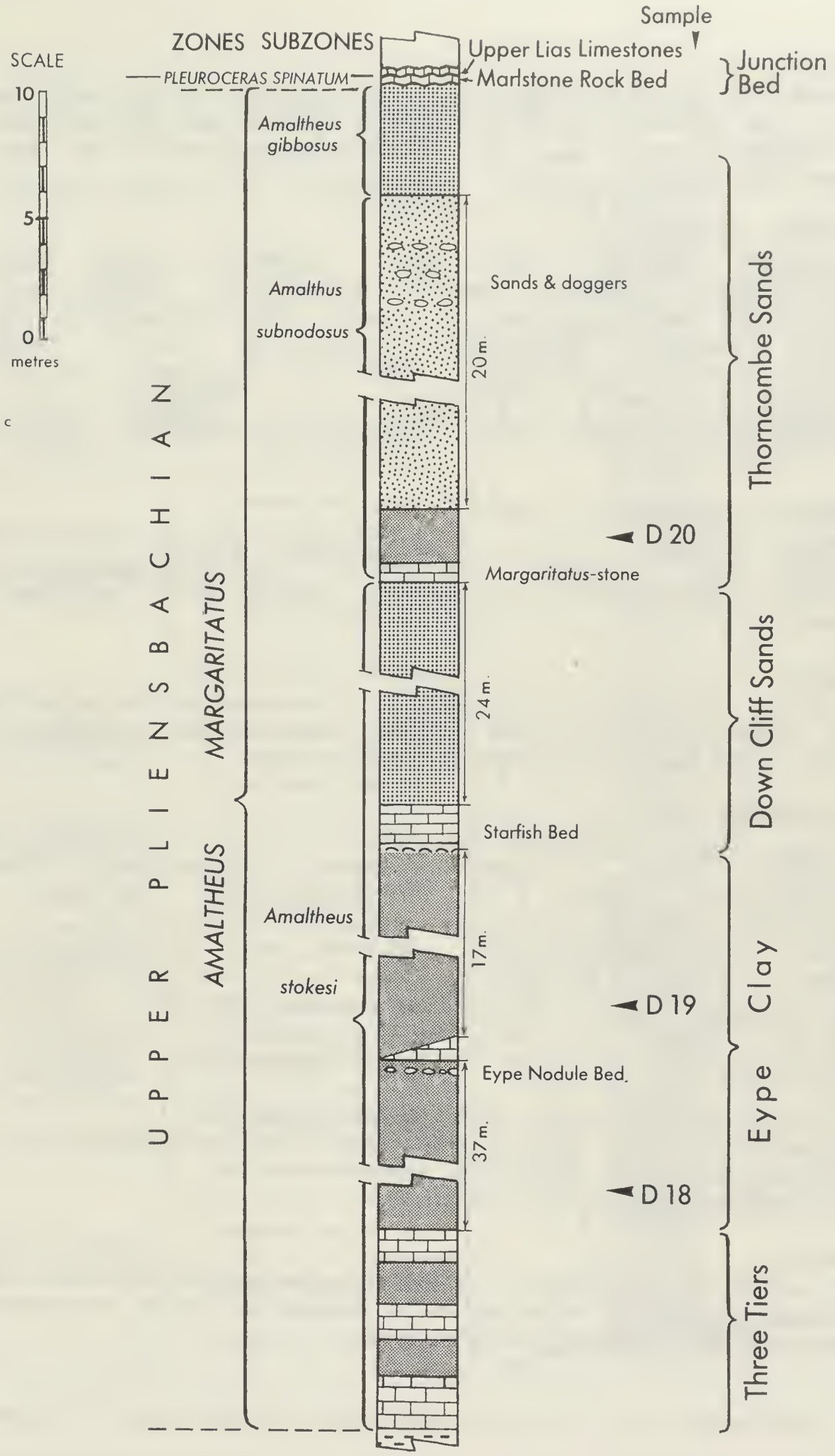


Fig. 6. Lithostratigraphy of the Upper Pliensbachian between Golden Cap and Thorncombe Beacon. (Redrawn after Howarth 1957).

Comments
Appearance of abundant L.muensteri acutiangulata is an event seen at the base of the subnodus Subzone throughout onshore Britain and the southern and northern North Sea. This abundance continues to the top of the margaritatus Zone.

OSTRACODA (IDB)
Acrocythere herrigi Park MS., Bairdia? molesta Apostolescu, Ektyphocythere sp.A Lord, Gramannella apostolescui Lord, Monoceratina amlingstadtensis Triebel and Bartenstein, Nanacythere simplex Herrig, Ogmoconcha contractula Triebel, Ogmaconchella aequalis (Herrig), O.bispinosa (Grundel), O.grundeli (Malz), O. cf. O.psuedospina (Herrig), Paracypris sp.1, Polycope cerasia Blake, ?Pseudohealdia truncata Malz, Trachycythere tubulosa seratina Triebel and Klingler.

CALCAREOUS NANNOFOSSILS (PRB)
Biscutum finchii (Crux), Crepidolithus crassus (Deflandre) Noel, Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood, Hay and Barnard.

Comments
The first occurrence of B.finchii is recorded in the margaritatus Zone (last occurrence falciferum Zone). Impoverished assemblage almost certainly the result of diagenetic destruction.

PALYNOMORPHS (JBR)
Spores: ?Baculatisporites comaumensis (Cookson) Potonie, Cyathidites australis Couper, C.minor Couper, Cyathidites Couper sp., Leptolepidites Couper sp., Osmundacidites wellmanii Couper, Retitriletes australclavatidites (Cookson) Schulz et al.,
Pollen: Albietineaepollenites Potonie sp., Alisporites microsaccus (Couper) Pocock, A.thomasii (Couper) Pocock, Alisporites Daugherty sp., Cerebropollenites mesozoicus (Couper) Nilsson, Chasmatosporites apertus (Rogalska) Nilsson, Classopollis classoides Pflug, Perinopollenites elatoides Couper, Podocarpidites Cookson ex Couper sp..
Acritarchs: Micrhystridium lymensis var. rigidum Wall.
Dinoflagellate cysts: Escharisphaeridia Erkmen and Sarjeant sp.
Prasinophycean algae: Tasmanites Newton sp..
Misc.: Botryococcus Kutzing sp.

Comments
The assemblage indicates a broad Sinemurian/Pliensbachian age and a nearshore environment adjacent to a region of high freshwater input. Clusters of Botryococcus are prominent.

The uppermost part of the Pliensbachian (spinatum Zone) is represented by a condensed limestone sequence, the Marlstone Rock Bed. The Marlstone Rock Bed (0-0.6m) is itself the lower part of a more substantial condensed limestone unit called the Junction Bed (0.5-2.6m, not including the Marlstone) which represents most of Toarcian time (tenuicostatum to basal

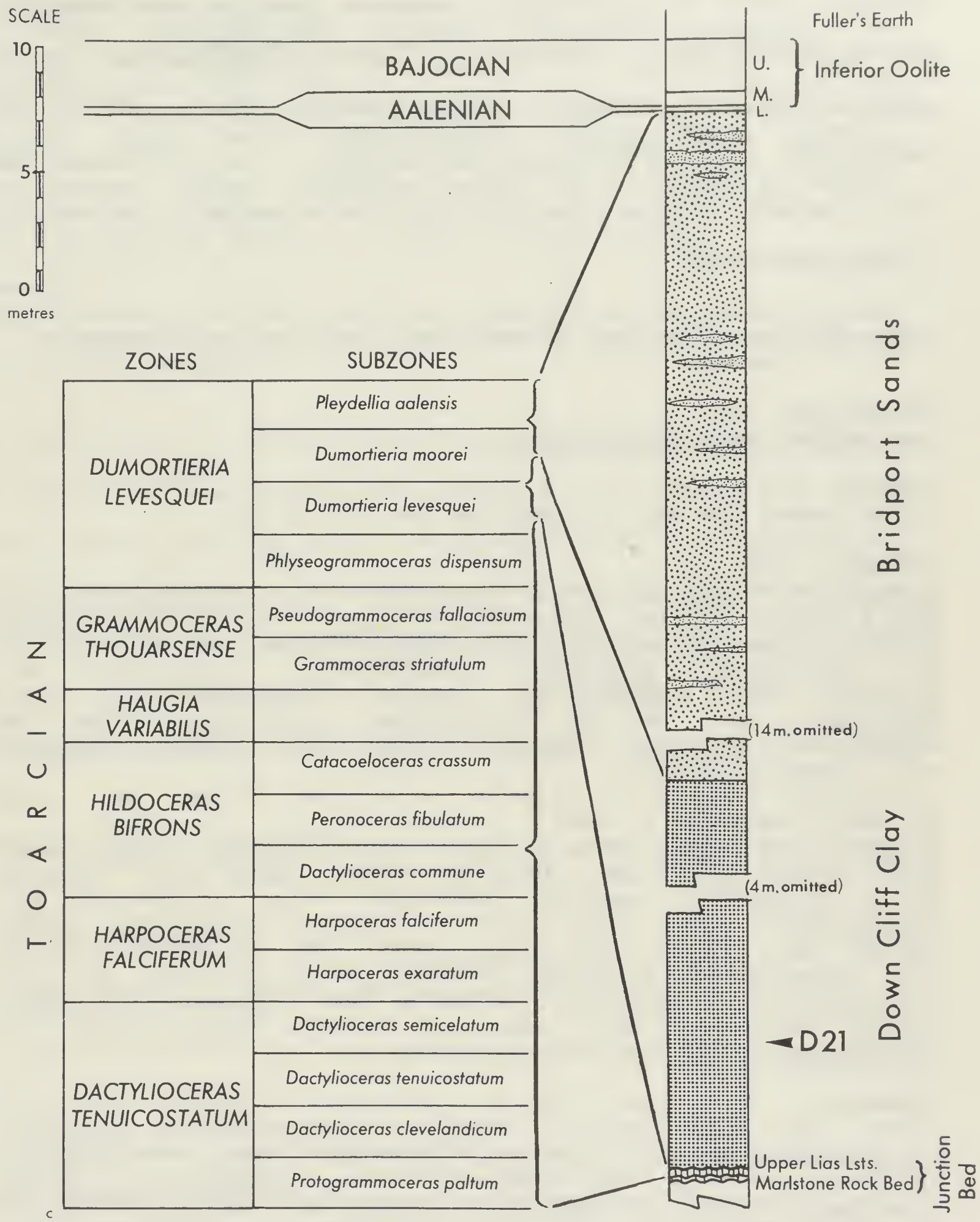


Fig. 7. Lithostratigraphy of the Toarcian, Aalenian and Bajocian stages between Thorncombe Beacon and Burton Bradstock.

levesquei Zones). Thin argillaceous bands have been recorded from the Junction Bed but it is dominantly a carbonate with numerous remanie ammonites and erosion surfaces. The Down Cliff Clay (21m) rests on the Junction Bed and is a silty clay representing parts of the levesquei and moorei Subzones, levesquei Zone. This unit can be sampled by the intrepid on Thorncombe Beacon.

Sample D21 (Down Cliff Clay, 5m above base; levesquei Zone, levesquei Subzone).

FORAMINIFERA (PC)
Lenticulina muensteri/acutiangulata

Comments
Richer samples have been obtained from Down Cliff by PC.

OSTRACODA (IDB)
Acrocythere herrigi Park MS., Acrocythere sp., Bairdiacypris sp., Bardia ohmerti Knitter, Cytherella toarcensis Bizon, Cytherelloidea cadomensis Bizon, Cytheropteron alafastigatum Fischer, Gen et sp.4, 5, 6, Kinkelinella semoisensis (Apostolescu), Kinkelinella sp., Krausella sp., Lophodentina cultrata Apostolescu et al., Macrocypris sp.2 and 3, Monoceratina scrobiculata Triebel and Bartenstein, Otocythere callosa Triebal and Klinger, Paracypris sp.3, Praeschuleridea sp..

CALCAREOUS NANNOFOSSILS (PRB)
Axopodorhabdus atavus (Grun et al.) Bown, Biscutum novum (Goy) Bown, B.intermedium Bown, Bussonius prinsii (Noel) Goy, Calyculus sp., Carinolithus superbus (Deflandre) Prins in Grun et al., Crepidolithus cavus Rood, Hay and Barnard, Discorhabdus ignotus (Gorka) Perch-Nielsen, Lotharingius hauffi Grun and Zweili in Grun et al., Lotharingius sigillatus (Stradner) Prins in Grun et al., Schizosphaerella punctulata Deflandre and Dangeard, Tubirhabdus patulus Prins ex Rood, Hay and Barnard, Staurolithites sp., Zeugrhabdotus erectus (Deflandre) Reinhardt.

Comments
Typical late Lower Jurassic assemblage characterised by L.haufii, L.sigillatus, B.prinsii, A.atavus, C.superbus, C.cavus and D.ignotus. The distinctive early Lower Jurassic forms, e.g. Parhabdolithus liasicus, Crucirhabdus primulus and Mitrolithus elegans have become extinct and distinctive Middle Jurassic forms e.g. Watznaueria and Stephanolithion are not yet present.

PALYNOMORPHS (JBR)
Spores: ?Contignisporites dunrobinensis (Couper) Schulz, Cyathidites minor Couper, Densiosporites crassus Tralau, Murospora Somers sp., Retitriletes austroclavatidites (Cookson) Schulz et al..
Pollen: Alisporites thomasii (Couper) Pocock, Alisporites Daugherty sp., Cerebropollenites mesozoicus (Couper) Nilsson, Chasmatosporites apertus (Rogalska) Nilsson, Classopollis classoides Pflug,

Perinopollenites elatoides Couper.
Acritarchs: Micrhystridium fragile Deflandre, M.lymensis var. gliscum Wall, M.lymensis var. rigidum Wall, M.recurvatum Valensi, Micrhystridium Deflandre sp.
Dinoflagellate cysts: Escharisphaeridea Erkmen and Sarjeant sp., ?Eyachra prisca Gocht, Nannoceratopsis ambonis Drugg, N.gracilis Alberti.
Prasinophycean algae: Tasmanites newtoni Wall, Tasmanites Newton, sp..
Misc.: Botryococcus Kutzing sp., foraminiferal test lining.

Comments
Dinoflagellate assemblage indicates a Toarcian to early Middle Jurassic age. The presence of marine and terrestrially derived forms suggest an open marine environment.

The uppermost unit of the Lower Jurassic, the Bridport Sands (20-30m) is of levesquei Zone age although the uppermost 2m have been placed in the basal Aalenian opalinum Zone. The Bridport Sands are lithologically distinctive with alternations of hard (calcareous) and soft (less calcareous or decalcified) sands. Individual bands are recognisable for up to 4km in the Bridport area but not in the Wytch Farm Oilfield in east Dorset where the Bridport Sands form a reservoir level (J.Storey, pers comm.). No samples were taken, although impoverished calcareous nannofossil assemblages have been recovered from the soft sands.

THE MIDDLE JURASSIC - BRIDPORT TO WEYMOUTH

The Middle Jurassic is the least well exposed part of the Dorset coast section. The lithologies concerned and the geomorphology of the area combine so that the impressive sea cliffs exposing the Lower Jurassic fade away near Burton Bradstock. The coast is shielded from the sea by the impressive depositional feature of the Chesil Beach. In addition, the Aalenian and Bajocian are represented by a thin, condensed limestone sequence, approximately 5m thick at Burton Bradstock where it can be seen capping the cliffs of Bridport Sands. The insignificance of the Aalenian in this classic section does much to explain the reluctance of British

workers in the past to adopt the stage. The divisions within this condensed sequence are impersistent even over short distances but are highly fossiliferous and clearly deposited in very shallow waters. Most of the classic inland sections have now vanished. The Upper Bathonian is accessible at two sites but the Lower and Middle Bathonian clays are not exposed. The Callovian part of the Oxford Clay (Lower and Middle Oxford Clay) was exposed in brick pits near Weymouth but Putton Lane has been infilled and Crook Hill is at present not open to visitors. Thus, no samples were collected from Aalenian, Bajocian or Callovian deposits.

Watton Cliff, Bridport (SY 45609065)

A fault block exposes Bathonian sediments, preserved within the area of the Lower Jurassic. An imposing cliff is formed of Upper Fuller's Earth and the Boueti Bed.

Sample D22 (Upper Fuller's Earth, "basal marl" of Wilson et al. (1958, p.103), 5m above sea wall; aspidoides Zone).

FORAMINIFERA (PC)
Lenticulina subalata (Reuss), Nodosaria pectinata (Terquem), Planularia pauperata Jones and Parker, Spirillina tenuissima, Spiroloculina sp.A (Coleman).

Comments
The appearance of N.pectinata is characteristic of the late Bathonian in Britain (Coleman, 1981). The record of Spiroloculina sp.A is considerably earlier than Coleman's late Callovian range.

OSTRACODA (LMS)
Cytherella fullonica Jones and Sherborn, Cytherelloidea catenulata (Jones and Sherborn), Fossaterquemula blakeana (Jones), Lophocythere ostreata (Jones and Sherborn), L.propinqua Malz, Micropneumatocythere brendae Sheppard, Monoceratina herburyensis Sylvester-Bradley, M.striata Triebel and Bartenstein, M.vulsa (Jones and Sherborne), Oligocythereis pullonica (Jones and Sherborn), Paracypris cf. P.terraefullonica (Jones and Sherborn), Praeschuleridea quadrata Bate, Progonocythere stilla Sylvester-Bradley, Terquemula bradiana (Jones).

Comments
Typical marine Upper Bathonian assemblage for Dorset, as in nearby Winterborne, Kingston and Seabarn Farm boreholes (Sheppard 1981).

CALCAREOUS NANNOFOSSILS (PRB)
Biscutum novum (Goy) Bown, Chiastozygus primitus Prins ex Rood, Hay

and Barnard, ?Conusphaera sp., Crepidolithus crassus (Deflandre) Noel, Ethmorhabdus gallicus Noel, Lotharingius crucicentralis (Medd) Grun and Zweili, L.hauffii Grun and Zweili in Grun et al., L.sigillatus (Stradner) Prins in Grun et al., Schizosphaerella punctulata Deflandre and Dangeard, Staurolithites sp., Stephanolithion speciosum Deflandre, Tubirhabdus patulus Prins ex Rood et al. Watznaueria barnesae (Black) Perch-Nielsen, Watznaueria britannica (Stradner), W.fossacinta (Black), Zeugrhabdotus erectus (Deflandre) Reinhardt.

Comments
W.britannica, W.fossacincta (Middle Bajocian-Barremian), E.gallicus (Bajocian-top Kimmeridgian) and S.speciosum (Bajocian - Oxfordian) represent typical Middle Jurassic assemblage components. Watznaueria spp. become dominant, taking the place of their Lower Jurassic precursors, Lotharingius spp.

PALYNOMORPHS (JBR)
Spores: Baculatisporites Thompson and Pflug sp., Cyathidites australis Couper, C.minor Couper, Ischyosporites vaerigatus (Couper) Schulz, Retitriletes (Pierce) Doring et al. sp., ?Todisporites minor Couper.
Pollen: Alisporites thomasii (Couper) Pocock, Callialasporites dampieri (Balme) Sukh Dev, C.microvelatus Schulz, C.segmentatus (Balme) Srivastava, C.turbatus (Balme) Schulz, Classopollis classoides Pflug, Cycadopites nitidus (Balme) Pocock.
Dinoflagellate cysts: ?Atopodinium Drugg sp., Ctenidodinium sellwoodii (Sarjeant) Stover and Evitt, Ellipsoidictyum gochtii Fensome, Energlynia acollaris (Dodekova) Sarjeant, Escharisphaeridia Erkmen and Sarjeant sp., Gonyaulacysta jurassica (Deflandre) Norris and Sarjeant ssp. adecta Sarjeant, G.pectinigera (Gocht) Fensome, Pareodinia ceratophora Deflandre, Tubotuberella dangeardii (Sarjeant) Stover and Evitt.
Prasinophycean algae: Tasmanites Newton sp..
Misc.: Pterospermella Eisenack sp., foraminiferal test lining.

Comments
A well preserved, relatively diverse palynoflora dominated by gymnosperm pollen with bissacate grains and Callialasporites especially prominent. The presence of abundant C.sellwoodii indicates a Bathonian age. The assemblage proportions suggest a fully marine environment and an equable climate.

Sample 23 (Upper Fuller's Earth Clay, top of "blue-grey marl" (Wilson et al.); aspidoides Zone).

FORAMINIFERA (PC)
Ammobaculites coprolithiformis (small coil var.), Cornuspira liasina, Dentalina spp. (smooth), Lenticulina muensteri group, Lingulina cornua, L.longiscata, Nubecularia triloculina, Pseudonodosaria sp., Spirillina tenuisimma, Spiroloculina sp.A, Vaginulina legumen (Linne).

Comments
V.legumen is restricted in southern England to the late Bathonian. L.longiscata is common in the Bathonian but ranges from Lower Jurassic to Callovian.

OSTRACODA (LMS)
As D22

CALCAREOUS NANNOFOSSILS (PRB)
Biscutum dubium (Noel) Grun in Grun et al., Ethmorhabdus gallicus Noel, Lotharingius hauffii Grun and Zweili in Grun et al., Lotharingius sigillatus (Stradner) Prins in Grun et al., Schizosphaerella punctulata Deflandre and Dangeard, Staurolithites sp., Watznaueria barnesae (Black) Perch-Nielsen, Watznaueria britannica (Stradner), Zeugrhabdotus erectus (Deflandre) Reinhardt.

PALYNOMORPHS (JBR)
Spores: Baculatisporites Thompson and Pflug sp., Cyathidites australis Couper, C.minor Couper, Densoisporites crassus Tralau, Retitriletes (Pierce) Doring et al. sp..
Pollen: Alisporites thomasii (Couper) Pocock, Callialasporites dampieri (Balme) Sukh Dev, C.microvelatus Schulz, C.segmentatus (Balme) Srivastava, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson, Classopollis classoides Pflug, Cycadopites nitidus (Balme) Pocock.
Dinoflagellate cysts: Ctenidodinium combazii Dupin, C.sellwoodii (Sarjeant) Stover and Evitt, Energlynia acollaris (Dodekova) Sarjeant, Escharisphaeridia Erkmen and Sarjeant, sp., Gonyaulacysta pectinigera (Gocht) Fensome, Pareodinia ceratophora Deflandre, Sentusidinium Sarjeant and Stover sp., Tubotuberella dangeardii (Sarjeant) Stover and Evitt.
Acritarchs: Micrhystridium recurvatum Valensi.
Prasinophycean algae: Tasmanites Newton sp..

Comments
The presence of C.combazii and C.sellwoodii strongly suggest a Bathonian age.

Sample 24 (Upper Fuller's Earth Clay, "blue shaley marl" (Wilson et al.); aspidoides Zone.

FORAMINIFERA (PC)
Ammobaculites coprolithiformis (Schwager), Lenticulina muensteri subalata sensu Coleman, Spiroloculina sp.A.

Comments
The first appearance of A.coprolithiformis is a conspicuous event in the British Jurassic. The species is consistent and common from the base of the Bathonian and through the Callovian (Coleman 1981; Gordon 1967), its earliest recorded British occurrence being from the early Bajocian (Morris 1982). The Barnard et al. (1982) observation that the earliest record of the species in Britain is in the late Callovian athleta Zone is superseded.

OSTRACODA (LMS)
As D22

CALCAREOUS NANNOFOSSILS (PRB)
Biscutum dubium (Noel) Grun in Grun et al., Biscutum depravatus (Grun and Zweili) Bown, ?*B.finchii Crux, B.intermedium Bown, B.novum (Goy) Bown, ?Conusphaera sp., Crepidolithus crassus (Deflandre) Noel, Discorhabdus criotus Bown, D.ignotus (Gorka)

Perch-Nielsen, D.patulus (Deflandre) Noel, Ethmorhabdus gallicus Noel, Lotharingius crucicentralis (Medd) Grun and Zweili, L.hauffii Grun and Zweili in Grun et al., L.sigillatus (Stradner) Prins in Grun et al., *Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Staurolithites sp., Stephanolithion octum (Rood and Barnard) Perch-Nielsen, Tubirhabdus patulus Prins ex Rood, Hay and Barnard, Triscutum Dockerill sp., Watznaueria britannica (Stradner), W.fossacinta (Black), Zeugrhabdotus erectus (Deflandre) Reinhardt. * reworked Lower Jurassic coccoliths.

Comments
S.octum ranges from Upper Bathonian - Upper Callovian.

PALYNOMORPHS (JBR)
Spores: Baculatisporites Thompson and Pflug sp., Cyathidites australis Couper, C.minor Couper, Foveotriletes van der Hammen ex Potonie sp., Leptolepidites major Couper, Taurocusporites Stover sp..
Pollen: Alisporites thomasii (Couper) Pocock, Alisporites Daugherty sp., Araucaricites australis Cookson, Callialasporites segmentatus (Balme) Srivastava, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson, Classopollis classoides Pflug, Podocarpidites Cookson ex Couper, sp..
Dinoflagellate cysts: Ctenidodinium combazii Dupin, Ctenidodinium sellwoodii (Sarjeant) Stover and Evitt, Escharisphaeridia Erkmen and Sarjeant sp., Ellipsoidictyum gochtii Fensome, Gonyaulacysta pectinigera (Gocht) Fensome, Meiourogonyaulax cf. M.caytonensis (Sarjeant) Sarjeant, Pareodinia ceratophora Deflandre.
Acritarchs: Micrhystridium Deflandre sp..
Prasinophycean algae: Tasmanites Newton sp..
Misc.: Pterospermella Eisenack sp..

The Fleet - Langton Hive Point and Herbury

Small outcrops occur on the landward side of The Fleet, near Langton Herring. At Langton Hive Point (SY 60608140) a small cliff exposes 3.6m of oyster beds overlying clay of the Upper Fuller's Earth clay. Sample taken in clay at base of cliff.

Sample D25 (Upper Fuller's Earth clay; aspidoides Zone?).

OSTRACODA (LMS)
Sparse assemblage of Micropneumatocythere.

CALCAREOUS NANNOFOSSILS (PRB)
Axopodorhabdus atavus (Grun et al.) Bown, Biscutum dubium (Noel) Grun in Grun et al., ?*B.finchii Crux, B.intermedium Bown, Chiastozygus primitus Prins ex Rood et al., ?Conusphaera sp., Crepidolithus cavus Rood et al., C.crassus (Deflandre) Noel, Discorhabdus criotus Bown, D.patulus (Deflandre) Noel, D. sp., Ethmorhabdus gallicus Noel, Lotharingius hauffii Grun and Zweili in Grun et al., L.sigillatus (Stradner) Prins in Grun et al., *Mitrolithus elegans Deflandre, *Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Stephanolithion

octum (Rood and Barnard) Perch-Nielsen, Stradnerlithus asymmetricus (Rood et al.) Medd, Triscutum Dockerill sp., Tubirhabdus patulus Prins ex Rood et al., Watznaueria barnesae (Black) Perch-Nielsen, W.britannica (Stradner), W.fossacinta (Black), W.strigosa (Grun and Zweili), Zeugrhabdotus erectus (Deflandre) Reinhardt. * reworked Lower Jurassic coccoliths.

PALYNOMORPHS (JBR)
Spores: Cyathidites australis Couper, Ischyosporites varigatus (Couper) Schulz, Leptolepidites rotundus Trelau.
Pollen: Alisporites thomasii (Couper) Pocock, Callialasporites microvelatus Schulz, C.turbatus (Balme) Schulz, Classopollis classoides Pflug.
Dinoflagellate cysts: Ctenidodinium combazii Dupin, Ellipsoidictyum gochtii Fensome, Korystocysta gochtii (Sarjeant) Woollam, Nannoceratopsis pellucida Deflandre, Pareodinia ceratophora Deflandre, Sentusidinium Sarjeant and Stover sp..
Misc.: foraminiferal test lining.

Comments
Abundant C.combazii is characteristic of the Bathonian and indicative of stable, fully marine conditions.

To the south-east, Herbury peninsula projects into The Fleet and a low cliff exposes the Boueti Bed with Upper Fuller's Earth clays below and Lower Forest Marble, of which the Boueti Bed is the basal member, above. This is the classic ostracod site of Sylvester-Bradley (1948).

Sample D26 (Upper Fuller's Earth clay, 1.8m below Boueti Bed; aspidoides Zone).

FORAMINIFERA (PC)
Cornuspira liasina, Dentalina mucronata Neugeboren, D. spp. (smooth), Lenticulina muensteri, Massilina dorsetensis Cifelli, Nodosaria opalini (Bartenstein), Reophax sp., Spirillina infima, Spirillina tenuissima, Spiroloculina sp.A.

Comments
The appearance of M.dorsetensis characterises the latest Bathonian (late aspidoides Zone - discus Zone) in southern Britain. The species is characteristic of Bathonian faunule D (Cifelli 1959, Coleman 1979, 1981) which is recognised between Bath (Avon) and Dorset.

OSTRACODA (LMS)
Cytherelloidea catenulata, Fossaterquemula blakeana, Lophcythere ostreata, L.propinqua, Marslatourella bullata Bate, Micropneumatocythere brendae, Monoceratina herburyensis, M.strata, M.visceralis (Jones and Sherborn), M.vulsa, Oligiocythereis fullonica, Paracypris assymetrica Sheppard (MS.), Parariscus bathonicus Oertli, Polycope sp., Progonocythere stilla, Terquemula bradiana.

Comments
Closely comparable to Upper Fuller's Earth Clay assemblages seen at Watton

Cliff, Bridport.

CALCAREOUS NANNOFOSSILS (PRB)
Biscutum dubium (Noel) Grun in Grun et al., Crepidolithus crassus (Deflandre) Noel, Ethmorhabdus gallicus Noel, Lotharingius hauffii Grun and Zweili in Grun et al., L.sigillatus (Stradner) Prins in Grun et al., Schizosphaerella punctulata Deflandre and Dangeard, Watznaueria barnesae (Black) Perch-Nielsen, Watznaueria britannica (Stradner), W.fossacinta (Black), Zeugrhabdotus erectus (Deflandre) Reinhardt.

PALYNOMORPHS (JBR)
Spores: Cyathidites australis Couper, C.minor Couper, Ischyosporites variegatus (Couper) Schulz, Leptolepidites rotundus Tralau, Uvaesporites argenteaeformis (Bolhovitina) Schulz.
Pollen: Alisporites thomasii (Couper) Pocock, Araucaricites australis Cookson, Callialasporites dampieri (Balme) Sukh Dev, C.microvelatus Schulz, C.segmentatus (Balme) Srivastava, C.turbatus (Balme) Schulz, Classopollis classoides Pflug, Podocarpidites Cookson, ex Couper sp., Vitreosporites pallidus (Reissinger) Nilsson.
Dinoflagellate cysts: Ctenidodinium combazii Dupin, C.sellwoodii (Sarjeant) Stover and Evitt, cf. Dichadogonyaulax? filepicata (Gocht) Jan du Chene et al., Escharisphaeridia Erkmen and Sarjeant sp., Sentusidinium Sarjeant and Stover sp..

Sample D27 (Lower Forest Marble, 0.4m above Boueti Bed; aspidoides Zone).

FORAMINIFERA (PC)
Cyclogyra liasina, Lenticulina muensteri subalata, Spiroloculina sp.A, Vaginulina legumen.

Comments
The continued presence of V.legumen is indicative of late Bathonian age.

OSTRACODA (LMS)
Bairdia hilda Jones, Cytherella fullonica, Cythereloidea catenulata, C.jugosa (Jones), C.longicosta Sheppard (MS.), Fastigatocythere juglandiea (Jones), Fossaterquemula blakeana, Glyptocythere guembeliana (Jones), Looneyella subtilis Oertli, Lophocythere ostreata, L.propinqua, Marslatourella bullata, Micropneumatocythere brendae, Monoceratina herburyensis, M.striata, M.visceralis, M.vulsa, Oligiocythereis fullonica, Paracypris assymetrica, Pariscus bathonicus, Polycope sp., Progonocythere stilla, Terquemula bradiana, Schuleridea (Eoschulerida) trigonalis (Jones).

Comments
Some new elements in an assemblage which is generally similar to that of Upper Fuller's Earth Clay but more diverse. Herbury is a classic ostracod locality from the work of Sylvester-Bradley (1948) in which ostracods were described from the Bonetic Bed itself. Type locality for important genera Lophocythere and Progonocythere.

CALCAREOUS NANNOFOSSILS (PRB)
Biscutum dubium (Noel) Grun in Grun et al., Crepidolithus crassus (Deflandre) Noel, Discorhabdus ?ignotus (Gorka) Perch-Nielsen, Ethmorhabdus gallicus Noel, Lotharingius hauffii Grun and Zweili in Grun et al., Schizosphaerella punctulata Deflandre and

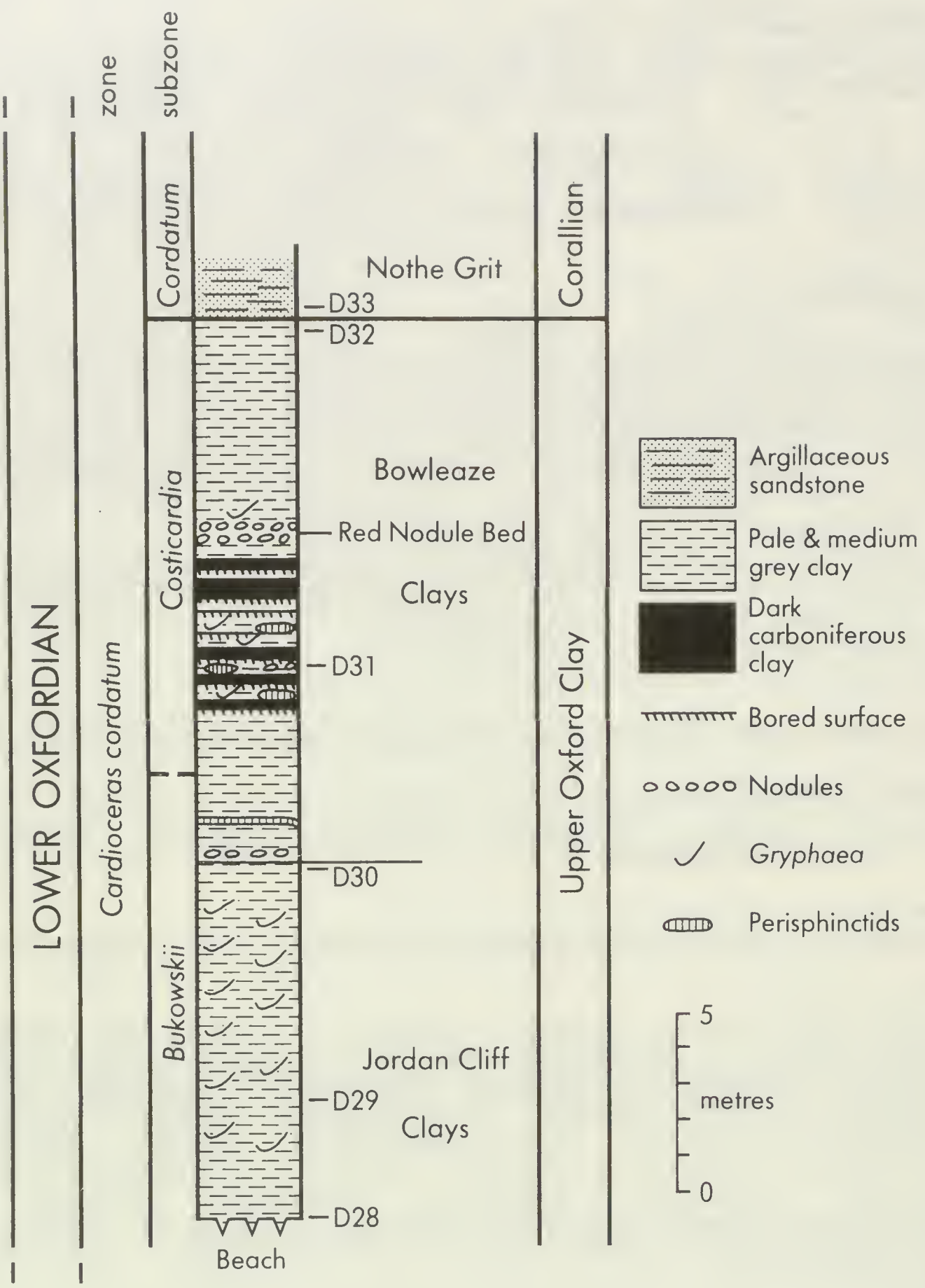


Fig. 8. Upper Oxford Clay (Lower Oxfordian) of Furzy Cliff. (After Wright 1986).

Dangeard, Staurolithites sp., Tubirhabdus patulus Prins ex Rood et al., Watznaueria barnesae (Black) Perch-Nielsen, Watznaueria britannica (Stradner), Watznaueria fossacinta (Black), Zeugrhabdotus erectus (Deflandre) Reinhardt.

PALYNOMORPHS (JBR)
Spores: Cyathidites minor Couper.
Pollen: Araucaricites australis Cookson, Callialasporites dampieri (Balme) Sukh Dev, Callialasporites microvelatus Schulz, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson, Perinopollenites elatoides Couper.
Dinoflagellate cysts: Ctenidodinium sellwoodii (Sarjeant) Stover and Evitt.
Prasinophycean algae: Tasmanites Newton sp..

UPPER JURASSIC - PORTLAND TO SWANAGE.

Oxfordian and Kimmeridgian units occur along the coast of east Dorset overlain by the Portlandian and non-marine sediments of the "Purbeckian" facies. As a consequence of the Weymouth Anticline structure the Portlandian is also exposed in spectacular fashion in the Isle of Portland, the type locality, together with basal Purbeck beds. Units of Oxfordian age can be examined in cliffs to the north and east of Weymouth, between Furzy Cliff (Bowleaze Cove) and Ringstead Bay.

Furzy Cliff, Bowleaze Cove (SY 701819) (fig.8)

Classic section in Upper Oxford Clay (Lower Oxfordian) recently described by Wright (1986). Samples in ascending order:

Sample D28 (Jordan Cliff Clays, cliff base; cordatum Zone, bukowskii Subzone).

FORAMINIFER (PC)
Ammobaculites coprolithiformis, Citharina serratocostata, Frondicularia franconica, Lenticulina muensteri, miliolid end chambers (?Nubeculinella bigoti), Tristix triangularis Barnard.

Comments
T.triangularis has not previously been reported younger than the bukowskii Subzone, cordatum Zone (Barnard et al. 1981).

OSTRACODS (NGF)
Eucytherura (Vesticytherura) costaeirregularis Whatley, ?Pseudocythere oblonga Fuller (MS.) Pseudoperissocytheridea parahieroglyphica Whatley.

CALCAREOUS NANNOFOSSILS (PRB)

Axopodorhabdus cylindratus (Noel) Wind and Wise in Wise and Wind, Biscutum dubium (Noel) Grun in Grun et al., Cyclagelosphaera margereli Noel, Discorhabdus patulus (Deflandre) Noel, Ethmorhabdus gallicus Noel, Hexapodorhabdus cuvillieri Noel, Octopodorhabdus decussatus (Manivit) Rood et al., Polypodorhabdus escaigi Noel, Stephanolithion bigotii Deflandre, Watznaueria britannica (Stradner), W.fossacinta (Black), W.strigosa (Grun and Zweili), Zeugrhabdotus erectus (Deflandre) Reinhardt.

Comments

These Upper Jurassic assemblages are essentially the same as those of the Middle Jurassic; the dominance of Watznaueria spp. continues.

PALYNOMORPHS (JBL)

Spores: Cyathidites minor Couper, Dictyophyllidites Couper sp., Gleicheniidites senonicus, Retitriletes austroclavatidites (Cookson) Schulz et al., R.semimuris (Danze-Corsin and Laveine) MacKellar, Staplinisporites caminus (Balme) Pocock.

Pollen: Alisporites robustus Rouse, A.thomasii (Couper) Pocock, Alisporites Daugherty sp., Callialasporites dampieri (Balme) Sukh Dev, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson, Cycadopidites (Woodhouse) Wilson and Webster sp., Eucommiidites troedssonnii Erdtman, Perinopollenites elatoides Couper, Podocarpidites Cookson ex Couper.

Dinoflagellate cysts: Apteodinium cf. granulatum Eisenack, Atopodinium prostatum Drugg, Belodinium asaphum Drugg, Chytroeisphaeridium chytroeides (Sarjeant) Downie and Sarjeant, Cleistosphaeridium tribuliferum (Sarjeant) Davey et al., Crussolia deflandrei Wolford and van Erve, Ctenidodinium ornatum (Eisenack) Deflandre, ?Ellipsoidictyum Klement sp., Endoscrinium galeritum (Deflandre) Vozzhennikova, Escharisphaeridia cf. pocockii (Sarjeant) Erkmen and Sarjeant, Escharisphaeridia Erkmen and Sarjeant sp., Gonyaulacysta eisenackii (Deflandre) Dodekova, G.jurassica adecta Sarjeant, G.jurassica adecta var. longicornis (Deflandre) Sarjeant, G.jurassica jurassica (Deflandre) Norris and Sarjeant, Leisbergia scarburghensis (Sarjeant) Berger, Meiourogonyaulax Sarjeant sp., Nannoceratopsis pellucida Deflandre, Pareodinia ceratophora Deflandre, Rigaudella aemula (Deflandre) Below, Rhynchodiniopsis cladophora (Deflandre) Below, Scriniodinium crystallinum (Deflandre) Klement, Sentusidinium creberbarbatum Erkmen and Sarjeant, Sentusidinium Sarjeant and Stover sp., Sirmiodinium grossii Alberti, Suruculosphaeridium vestitum (Deflandre) Davey et al., Tubotuberella dangeardii (Sarjeant) Stover and Evitt, Valensiella ovulum (Deflandre) Eisenack, Wanaea thysanota Woollam.

Prasinophycean algae: Tasmanites Newton sp.

Misc.: foraminiferal test linings.

Comments

The presence of C.deflandrei together with L.scarburghensis and W.thysanota indicate a basal Oxfordian age. Bisaccate pollen is very abundant, spores rare, and dinoflagellate cysts are abundant and diverse suggesting an environment well off-shore.

Sample D29 (Jordan Cliff Clays, 3m above cliff base; cordatum Zone, bukowskii Subzone).

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Frondicularia franconica, F.nikitini Uhlig, Lenticulina major, L.muensteri, Marginulina glabra d'Orbigny, Pseudonodosaria oveyi Barnard.

OSTRACODS (NGF)
Pseudocythere brevicaudata Fuller (MS.), ?P.oblonga Fuller (MS.), Pseudoperissocytheridea parahieroglyphica Whatley.

CALCAREOUS NANNOFOSSILS (PRB)
Axopodorhabdus cylindratus (Noel) Wind and Wise in Wise and Wind, Biscutum dubium (Noel) Grun in Grun et al., B. ?novum (Goy) Bown, Cyclagelosphaera margereli Noel, Discorhabdus jungi Noel, D.patulus (Deflandre) Noel, Ethmorhabdus gallicus Noel, Hexapodorhabdus cuvillieri Noel, Polypodorhabdus escaigi Noel, Staurolithites sp., Stephanolithion bigotii Deflandre, Watznaueria barnesae (Black) Perch-Nielsen, W.britannica (Stradner), W.fossacincta (Black), W.reinhardtii Rood et al., W.strigosa (Grun and Zweili), Zeugrhabdotus erectus (Deflandre) Reinhardt.

Comments
S.bigotii is an important and distinctive marker species ranging from Callovian - Kimmeridgian.

PALYNOMORPHS (JBR)
Spores: Cyathidites australis Couper, C.minor Couper, Retitriletes austroclavatidites (Cookson) Schulz et al..
Pollen: Alisporites thomasii (Couper) Pocock, Alisporites Daugherty sp., Callialasporites segmentatus (Balme) Srivastava, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson.
Dinoflagellate cysts: Atopodinium prostatum Drugg, Cleistosphaeridium polytrichum (Valensi) Davey et al., Crussolia deflandrei Wolford and van Erve, Ctenidodinium ornatum (Eisenack) Deflandre, Endoscrinium galeritum (Deflandre) Vozzhennikova, Gonyaulacysta jurassica adecta Sarjeant, G.jurassica adecta var. longicornis (Deflandre) Sarjeant, G.jurassica jurassica (Deflandre) Norris and Sarjeant, Hystrichodinium pulchrum Deflandre, Leisbergia scarburghensis (Sarjeant) Berger, Mendicodinium groenlandicum (Pocock and Sarjeant) Davey, Nannoceratopsis pellucida Deflandre, Pareodinia ceratophora Deflandre, Rigaudella aemula (Deflandre) Below, Rhynchodiniopsis cladophora (Deflandre) Below, Scriniodinium crystallinum (Deflandre) Klement, Sentusidinium creberbarbatum Erkmen and Sarjeant, Sentusidinium Sarjeant and Stover sp., Sirmiodinium grossii Alberti, skolochorate cyst indet., Systematophora Klement sp., Wanaea fimbriata Sarjeant, W.thysanota Woollam.
Acritarchs: Caddasphaera halosa (Filatoff) Fenton et al.. Micrhystridium Deflandre sp.
Misc.: foraminiferal test linings.

Sample 30 (Jordan Cliff Clays, 10m above cliff base, below junction with Bowleaze Clays; cordatum Zone, bukowskii Subzone).

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Frondicularia franconica, Epistomina parastelligera, Epistomina stellicostata Bilecka and Pozaryski, Lenticulina muensteri.

OSTRACODA (NGF)
Terquemula multicostata (Oertli).

CALCAREOUS NANNOFOSSILS (PRB)
Axopodorhabdus cylindratus (Noel) Wind and Wise in Wise and Wind, Biscutum dubium (Noel) Grun in Grun et al., Cyclagelosphaera margereli Noel, Ethmorhabdus gallicus Noel, Hexapodorhabdus cuvillieri Noel, Polypodorhabdus escaigi Noel, Stephanolithion bigotii Deflandre, Triscutum Dockerill sp., Watznaueria barnesae (Black) Perch-Nielsen, Watznaueria britannica (Stradner), W.fossacincta (Black), W.reinhardtii Rood et al., W.strigosa (Grun and Zweili), Zeugrhabdotus erectus (Deflandre) Reinhardt.

PALYNOMORPHS (JBR)
Spores: Concavissimisporites verrucosus Delcourt and Sprumont, Cyathidites minor Couper, Ischyosporites variegatus (Couper) Schulz, Ischyosporites Balme sp., Lycopodiacidites rugulatus (Couper) Schulz, Retitriletes semimuris (Danze-Corsin and Laveine) MacKellar, ?Verrucosisporites (Ibrahim) Potonie and Kremp sp..
Pollen: Alisporites rotundus Rouse, A.thomasii (Couper) Pocock, Araucaricites australis Cookson, Callialasporites dampieri (Balme) Sukh Dev, C.microvelatus Schulz, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson, ?Chasmatosporites Nilsson sp., Classopollis classoides Pflug, Cycadopidites nitidus (Balme) Pocock, Perinopollenites elatoides Couper.
Dinoflagellate cysts: Belodinium asaphum Drugg, Chlamydophorella cf. nyei Cookson and Eisenack, Compositosphaeridium polonicum (Gorka) Erkmen and Sarjeant, ?Dinopterygerum absidatum Drugg, Endoscrinium galeritum (Deflandre) Vozzhennikova, Endoscrinium (Klement) Vozzhennikova sp., Escharisphaeridia Erkmen and Sarjeant sp., Gonyaulacysta jurassica adecta Sarjeant, G.jurassica adecta var. longicornis (Deflandre) Sarjeant, G.jurassica jurassica (Deflandre) Norris and Sarjeant, gonyaulacoid cyst indet., Leisbergia scarburghensis (Sarjeant) Berger, Mendicodinium groenlandicum (Pocock and Sarjeant) Davey, Nannoceratopsis pellucida Deflandre, Pareodinia ceratophora Deflandre, Rigaudella aemula (Deflandre) Below, Rhynchodiniopsis cladophora (Deflandre) Below, Sentusidinium creberbarbatum Erkmen and Sarjeant, Sirimiodiniopsis orbis Drugg, Sirmiodinium grossii Alberti, skolochorate cyst indet., Tubotuberella apetela (Cookson and Eisenack) Ioannides et al., Tubotuberella sphaerocephalis Vozzhennikova.
Misc.: Botryococcus Kutzing sp., foraminiferal test lining.

Comments
Well-preserved assemblage with abundant bisaccate pollen and foraminiferal test linings and a relatively diverse dinoflagellate flora; indicative of an open marine situation. The presence of G.jurassica adecta and G.jurassica jurassica together with L.scarburghensis gives an early Oxfordian age.

Sample D31 (Bowleaze Clays, 5.5m above junction with Jordan Cliff Clays; cordatum Zone, costicardia Subzone).

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Frondicularia franconica, Epistomina parastelligera (Hofker), Lenticulina major (Bornemann), L.muensteri, Lenticulina quenstedti.

CALCAREOUS NANNOFOSSILS (PRB)
Axopodorhabdus cylindratus (Noel) Wind and Wise in Wise and Wind, Biscutum dubium (Noel) Grun in Grun et al., Cyclagelosphaera margereli Noel, Ethmorhabdus gallicus Noel, Hexapodorhabdus cuvillieri Noel, Polypodorhabdus escaigi Noel, Stephanolithion bigotii Deflandre, Triscutum Dockerill sp., Watznaueria barnesae (Black) Perch-Nielsen, W.britannica (Stradner), W.fossacincta (Black), W.strigosa (Grun and Zweili), Zeugrhabdotus erectus (Deflandre) Reinhardt.

PALYNOMORPHS (JBR)
Spores: ?Auritulinasporites Nilsson sp., Cyathidites australis Couper, Cyathidites minor Couper, Ischyosporites variegatus (Couper) Schulz, Leptolepidites major Couper, Retitriletes austroclavatidites (Cookson) Schulz et al..
Pollen: Alisporites thomasii (Couper) Pocock, Alisporites Daugherty sp., Callialasporites dampieri (Balme) Sukh Dev, C.microvelatus Schulz, C.segmentatus (Balme) Srivastava, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson, Perinopollenites elatoides Couper, Podocarpidites Cookson ex Couper, Vitreosporites pallidus (Reissinger) Nilsson.
Dinoflagellate cysts: Atopodinium prostatum Drugg, Chlamydophorella Cookson and Eisenack sp., Endoscrinium galeritum (Deflandre) Vozzhennikova, ?Ellipsoidictyum cinctum Klement, Gonyaulacysta jurassica adecta Sarjeant, G.jurassica jurassica (Deflandre) Norris and Sarjeant, Korystocysta pachyderma (Deflandre) Woolam, Leisbergia scarburghensis (Sarjeant) Berger, ?Mendicodinium groenlandicum (Pocock and Sarjeant) Davey, Rhynchodiniopsis cladophora (Deflandre) Below, Rigaudella aemula (Deflandre) Below, Scriniodinium crystallinum (Deflandre) Klement, Sentusidinium creberbarbatum Erkmen and Sarjeant, Sentusidinium Sarjeant and Stover sp., Sirmiodinium grossii Alberti, Systematophora areolata Klement, Tubotuberella dangeardii (Sarjeant) Stover and Evitt,
Achritarchs: Micrhystridium Deflandre sp..
Prasinophycean algae: Tasmanites Newton sp..
Misc.: foraminiferal test linings.

Comments
G.jurassica adecta vey common.

Sample D32 (Bowleaze Clays, 14.5m above base and immediately below Nothe Grit; cordatum Zone, costicardia Subzone).

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Citharina serratocostata (Guembel), Dentalina spp. (smooth), Eoguttulina liassica, Frondicularia franconica, Haplophragmoides canui, H.canui (uncoiled var.), Lenticulina muensteri, Planularia angustissima (Wisniowski),

P.eugenii (Terquem) sensu Barnard et al., Vaginulina pasquetae Bizon.

Comments
The appearance of V.pasquetae marks the base of the cordatum Zone in Britain. The A.coprolithiformis tests contain other foraminiferal tests as agglutinants, including miliolids and H.canui.

OSTRACODA (NGF)
Eucytherura (Vesticytherura) costaeirregularis Whatley, Procytherura sp. (?Cytherura aff. dorsetensis of Bate 1963) Procytherura sp., Pseudocythere brevicaudata Fuller (MS.), P.oblonga Fuller (MS.).

CALCAREOUS NANNOFOSSILS (PRB)
Axopodorhabdus cylindratus (Noel) Wind and Wise in Wise and Wind, Biscutum dubium (Noel) Grun in Grun et al., Cyclagelosphaera margereli Noel, Discorhabdus sp., Ethmorhabdus gallicus Noel, Hexapodorhabdus cuvillieri Noel, Lotharingius hauffii Grun and Zweili in Grun et al., Polypodorhabdus escaigi Noel, Stephanolithion bigotii Deflandre, Triscutum Dockerill sp., Watznaueria barnesae (Black) Perch-Nielsen, W.britannica (Stradner), W.fossacincta (Black), Zeugrhabdotus erectus (Deflandre) Reinhardt.

PALYNOMORPHS (JBR)
Spores: Cyathidites australis Couper, C.minor Couper, Duplexisporites problematicus (Couper) Playford and Dettman, Tripartina variabilis Maljavkina, Uvaesporites argentaeaformis (Bolkhovitina) Schulz.
Pollen: Alisporites thomasii (Couper) Pocock, Araucaricites australis Cookson, Callialasporites dampieri (Balme) Sukh Dev, C.segmentatus (Balme) Srivastava, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson, Classopollis classoides Pflug, Cycadopidites nitidus (Balme) Pocock, Cycadopidites (Woodhouse) Wilson and Webster sp., Perinopollenites elatoides Couper.
Dinoflagellate cysts: Compositosphaeridium polonicum (Gorka) Erkmen and Sarjeant, Ctenidodinium sellwoodii (Sarjeant) Stover and Evitt, Escharisphaeridia Erkmen and Sarjeant sp., Gonyaulacysta jurassica adecta Sarjeant, G.jurassica jurassica (Deflandre) Norris and Sarjeant, Hystrichosphaerina orbifera (Klement) Stover and Evitt, Korystocysta pachyderma (Deflandre) Woollam, Meiourogonyaulax Sarjeant sp., Pareodinia ceratophora Deflandre, ?Prolixosphaeridium Davey et al., Sentusidinium rioulltii (Sarjeant) Sarjeant and Stover, Sentusidinium Sarjeant and Stover sp., Stephanelytron scarburghense Sarjeant, Tubotuberella apatela (Cookson and Eisenack) Ioannides et al., Tubotuberella dangeardii (Sarjeant) Stover and Evitt.
Achritarchs: Micrhystridium Deflandre sp..
Prasinophycean algae: Tasmanites Newton sp.
Misc.: foraminiferal test linings.

Sample D33 (Nothe Grit, base; cordatum Zone, cordatum Subzone).

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Frondicularia franconica Guembel, Haplophragmoides canui (Cushman) (involute var.), Lenticulina muensteri group, Lenticulina quenstedti (Guembel).

Comments
Abundant A.coprolithiformis is characteristic of the Oxford Clay in southern Britain.

OSTRACODA (NGF)
Macrodentina (Macrodentina) tenuistriata Malz.
Absent from samples D28-33 but expected within this stratigraphic range are the following:
Bythoceratina (Praebythoceratina) parascrobiculata Fuller, Cytherella fullonica Jones and Sherborn, Cytherelloidea paraweberi Oertli, Macrocypris aequabilis Oertli, Nophrecythere cruciata oxfordiana (Lutze), Polycope sububiquita (Whatley), Progonocythere multipunctata Whatley, P.parastilla Whatlet, Terquemula redcliffensis Fuller. There are also a number of small specimens representing the genera Pseudocythere Sars, Procytherura Whatley, Cytherura Sars and Eucytherura (Vesticytherura) Grundel.

CALCAREOUS NANNOFOSSILS (PRB)
Cyclagelosphaera margereli Noel, Lotharingius sigillatus (Stradner) Prins in Grun et al., Watznaueria britannica (Stradner).

PALYNOMORPHS (JBR)
Pollen: Alisporites thomasii (Couper) Pocock, Cerebropollenites mesozoicus (Couper) Nilsson, Podocarpidites Cookson ex Couper.
Dinoflagellate cysts: Ctenodinium sellwoodii (Sarjeant) Stover and Evitt, gonyaulacoid indet., Rhynchodiniopsis cladophora (Deflandre) Below, Scriniodinium crystallinum (Deflandre) Klement, skolochorate indet..

Comments
S.crystallinum, R.cladophora and C.sellwoodii indicate a broad late Callovian/Oxfordian age. Relative proportions of palynomorphs suggest an open ocean environment.

Redcliff, Bowleaze Cove (SY 70808180) (fig.9).

Above the Oxford Clay occurs a series of lithologically varied rocks which are collectively described as the Corallian (~60m), which consist of grits, clays, oolites, etc. of shallow water origin and range in age from late Lower Oxfordian to Upper Oxfordian. The Corallian is succeeded by clays of Kimmeridgian age. Lowermost Corallian units can be seen to the east of Bowleaze Cove, in the cliff near Pontins Hotel (venue of the 1956 European Micropalaeontological Colloquium).

Sample 34 (Nothe Grit, Bed 8 Arkell (1947, p.53), base of cliff; cordatum Zone, cordatum Subzone).

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Haplophragmoides canui, Lenticulina major, Lenticulina muensteri, Planularia eugenii, Vaginulina pasquetae Bizon.

OSTRACODA
No ostracods were recovered in this sample but samples from the same formation have yielded:
Nophrecythere cruciata oxfordiana (Lutze), Pseudoperissocytheridea parahieroglyphica Whatley, Procytherura costaprominens Fuller (MS.) P.tenuicostata Fuller (MS.), Schuleridea parva Fuller (MS.).

CALCAREOUS NANNOFOSSILS (PRB)
Cyclagelosphaera margereli Noel, Watznaueria britannica (Stradner), W.fossacinta (Black) W.strigosa (Grun and Zweili).

Comments
Impoverished assemblage, poor preservation.

PALYNOMORPHS (JBR)
Spores: Cyathidites minor Couper, spore indet..
Pollen: Alisporites robustus Rouse, A.thomasii (Couper) Pocock, Alisporites Daugherty, 1941 sp., Callialasporites dampieri (Balme) Sukh Dev, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson.
Dinoflagellate cysts: Adnatosphaeridium caulleryi (Deflandre) Willians and Downie, Compositosphaeridium polonicum (Gorka) Erkmen and Sarjeant, Ctenidodinium ornatum (Eisenack) Deflandre, C. cf. C.sellwoodii (Sarjeant) Stover and Evitt, Ctenododinium Deflandre sp., Endoscrinium luridum (Deflandre) Gocht, E.galeritum (Deflandre) Vozzhennikova, Gonyaulacysta centriconnata Riding, G.eisenackii (Deflandre) Dodekova, G.jurassica Norris and Sarjeant, Leisbergia scarburghensis (Sarjeant) Berger, Nannoceratopsis pellucida Deflandre, Rhynchodiniopsis cladophora (Deflandre) Below, Rigaudella aemula (Deflandre) Below, Sentusidinium creberbarbatum Erkmen and Sarjeant, Sentusidinium Sarjeant and Stover sp., ?Sirmiodinium grossii Alberti, Tubotuberella Vozhennikova sp.
Acritarchs: Micrhystridium fragile Deflandre, M.lymensis var. rigidum Wall, Micrhystridium Deflandre sp..
Misc.: foraminiferal test linings.

Sample D35 (Nothe Clay, top Bed 12 Arkell; densiplicatum Zone, maltonense Subzone).

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Epistomina parastelligera, Lenticulina muensteri.

OSTRACODA (NGF)
?Pseudocythere oblonga Fuller (MS.)

CALCAREOUS NANNOFOSSILS (PRB)
Axopodorhabdus cylindratus (Noel) Wind and Wise in Wise and Wind, Biscutum dubium (Noel) Grun in Grun et al., Cyclagelosphaera

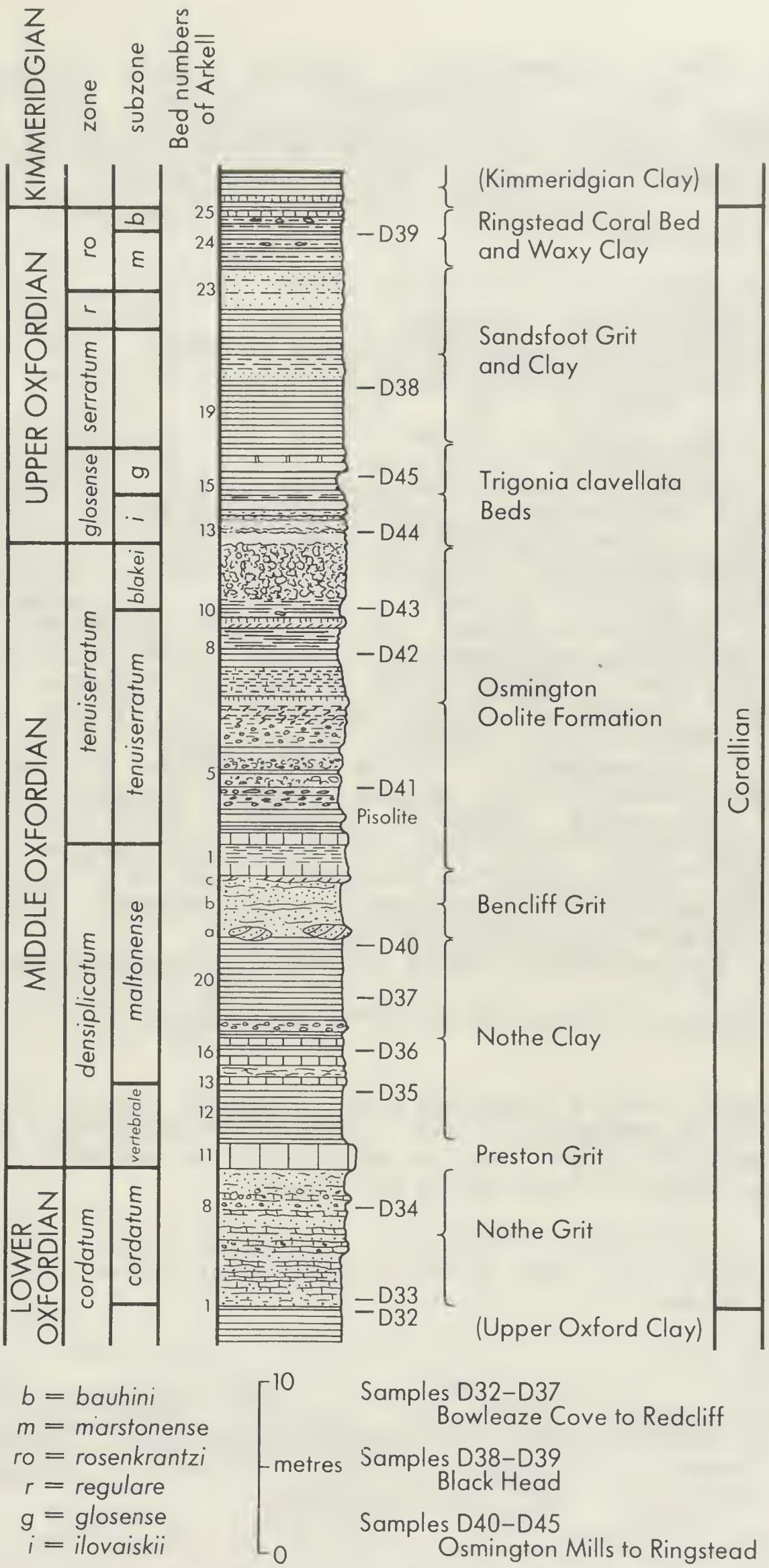


Fig. 9. Corallian (Oxfordian) lithostratigraphy between Furzy Cliff and Ringstead Bay. (Redrawn from Arkell 1947).

margereli Noel, Ethmorhabdus gallicus Noel, Hexapodorhabdus cuvillieri Noel, Polypodorhabdus escaigi Noel, Retacapsa schizobrachiata (Gartner) Grun, Schizosphaerella punctulata Deflandre and Dangeard, Stephanolithion bigotii Deflandre, Triscutum Dockerill sp., Watznaueria barnesae (Black) Perch-Nielsen, W.britannica (Stradner), W.fossacincta (Black), Zeugrhabdotus erectus (Deflandre) Reinhardt.

PALYNOMORPHS (JBR)
Spores: Cyathidites australis Couper, C.minor Couper, Concavimmisisporites verrucosus Delcourt and Sprumont.
Pollen: Alisporites robustus Rouse, A.thomasii (Couper) Pocock, Alisporites Daugherty sp., Araucaricites australis Cookson, Callialasporites dampieri (Balme) Sukh Dev, C.segmentatus (Balme) Srivastava, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson, Perinopollenites elatoides Couper.
Dinoflagellate cysts: Chytroeisphaeridium chytroeides (Sarjeant) Downie and Sarjeant, Cleistosphaeridium polytrichrum (Valensi) Davey et al., Compositosphaeridium polonicum (Gorka) Erkmen and Sarjeant, Ctenidodinium ornatum (Eisenack) Deflandre, Ctenidodinium cf. C.sellwoodii (Sarjeant) Stover and Evitt, ?Endoscrinium luridum (Deflandre) Gocht, Escharisphaeridia Erkmen and Sarjeant sp., dinoflagellate indet., Gonyaulacysta eisenackii (Deflandre) Dodekova, Gonyaulacysta jurassica adecta Sarjeant, G.jurassica jurassica (Deflandre) Norris and Sarjeant, G.pectinigera (Gocht) Fensome, Leisbergia scarburghensis (Sarjeant) Berger, Mendicodinium groenlandicum (Pocock and Sarjeant) Davey, Pareodinia ceratophora Deflandre, Rigaudella aemula (Deflandre) Below, Sentusidinium creberbarbatum Erkmen and Sarjeant, S.rioultii (Sarjeant) Sarjeant and Stover, Sentusidinium Sarjeant and Stover sp., Stephanelytron redcliffense Sarjeant, Systematophora areolata Klement, S.penicillata (Ehrenberg) Sarjeant, Systematophora Klement sp.
Acritarchs: Micrhystridium fragile Deflandre, Micrhystridium Deflandre sp..
Misc.: Botryococcus Kutzing, foraminiferal test linings.

Comments
Well-preserved, diverse assemblage with G.jurassica adecta, G.jurassica jurassica, L.scarburghensis and S.areolata indicating a Middle Oxfordian age. The high levels of both marine and terrestrially derived palynomorphs suggest an open marine environment,

Sample D36 (Nothe Clay, ?Bed 16 Arkell; densiplicatum Zone, maltonense Subzone).

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Frondicularia franconica, Lenticulina major, Lenticulina muensteri, Nubeculinella bigoti Cushman (on shell fragment in A.coprolithiformis test), Ophshalmidium strumosum (Gumbel), Planularia protracta (Bornemann), Quinqueloculina horelli Barnard et al., Spirillina tenuissima.

Comments
Q.horelli, first described only from the Lower Oxfordian of Weymouth (Barnard et al. 1981), is common in this sample and clearly ranges into the Middle Oxfordian. This may equate with Medd's (1982) record of Quinqueloculina sp. in the Middle Oxfordian of the Winterbourne Kingston

Borehole.

OSTRACODA (NGF)
Nophrecythere cruciata oxfordiana (Lutze), Pseudocythere spp., Progonocythere multipunctata Whatley, Schuleridea triebeli (Steghaus), Terquemula multicostata (Oertli).

CALCAREOUS NANNOFOSSILS (PRB)
Axopodorhabdus cylindratus (Noel) Wind and Wise in Wise and Wind, Biscutum dubium (Noel) Grun in Grun et al., Cyclagelosphaera margereli Noel, Stephanolithion bigotii Deflandre, Watznaueria britannica (Stradner), Watznaueria fossacincta (Black).

PALYNOMORPHS (JBR)
Spores: Cyathidites australis Couper, C.minor Couper, Dictyophyllidites mortoni (De Jersey) Playford and Dettman, Foveotriletes subtriangularis Brenner, Leptolepidites Couper sp, Lycopodiacidites cerniidites (Ross) Brenner, Retitriletes austroclavatidites (Cookson) Schulz et al., Staplinisporites caminus (Balme) Pocock.
Pollen: Alisporites robustus Rouse, A.thomasii (Couper) Pocock, Alisporites Daugherty sp., Callialasporites segmentatus (Balme) Srivastava, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson, Perinopollenites elatoides Couper.
Dinoflagellate cysts: Ambonosphaera calloviana Fensome, Cleistosphaeridium polytrichum (Valensi) Davey et al., dinocyst indet., Gonyaulacysta jurassica adecta var. longicornis (Deflandre) Sarjeant, G.jurassica jurassica (Deflandre) Norris and Sarjeant, Mendicodinium groenlandicum (Pocock and Sarjeant) Davey, Pareodinia ceratophora Deflandre, Rigaudella aemula (Deflandre) Below, Sentusidinium creberbarbatum Erkmen and Sarjeant, Sentusidinium Sarjeant and Stover sp., skolochorate cyst indet., Stephanelytron redcliffense Sarjeant, Systematophora areolata Klement.
Acritarchs: Micrhystridium Deflandre sp..
Prasinophycean algae: Tasmanites Newton sp.
Misc.: foraminiferal test linings.

Sample D37 (Nothe Clay, Bed 20 Arkell; desiplicatum Zone, maltonense Subzone).

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Lenticulina muensteri, Planularia protracta.

OSTRACODA (NGF)
Macrodentina (Macrodentina) tenuistriata Malz.

CALCAREOUS NANNOFOSSILS (PRB)
Cyclagelosphaera margereli Noel, Watznaueria fossacincta (Black).

PALYNOMORPHS (JBR)
Spores: Cyathidite australis Couper, C.minor Couper, Densoisporites Weyland and Krieger, Ischyosporites variegatus (Couper) Schulz, spore indet..
Pollen: Alisporites thomasii (Couper) Pocock, Alisporites Daugherty sp., Callialasporites dampieri (Balme) Sukh Dev, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson,

Perinopollenites elatoides Couper. Dinoflagellate cysts: Ambonosphaera calloviana Fensome, Compositosphaeridium polonicum (Gorka) Erkmen and Sarjeant, Cleistosphaeridium tribuliferum (Sarjeant) Davey et al., ?Ctenidodinium Deflandre emend. Wollam sp., Ellipsoidictyum Klement sp., ?Endoscrinium luridum (Deflandre) Gocht, Pareodinia ceratophora Deflandre, Rhynchodiniopsis cladophora (Deflandre) Below, Sentusidinium creberbarbatum Erkmen and Sarjeant, Sentusidinium Sarjeant and Stover sp., Systematophora areolata Klement.
Misc.: foraminiferal test linings.

Comments
S.areolata and ?E.luridum indicate an age no older than basal Middle Oxfordian.

Black Head (SY 72658190) (SY 72668190)

The lithostratigraphy of Black Head has been discussed by Brookfield (1978), who recognises the "Passage Beds" of Blake (1875) in which the Oxfordian/Kimmeridgian boundary falls.

Sample D38 (Sandsfoot Clay, high Bed 19 Arkell; serratum Zone).

FORAMINIFERA (PC)
Glomospirella sp., Lenticulina muensteri.

OSTRACODA (NGF)
?Galliaecytheridea sp. (probably G.postrotunda Oertli), Schuleridea triebeli (Steghaus).

CALCAREOUS NANNOFOSSILS (PRB)
Biscutum dubium (Noel) Grun in Grun et al., Cyclagelosphaera margereli Noel, *Crepidolithus crassus (Deflandre) Noel, Discorhabdus Noel sp., *Parhabdolithus liasicus Deflandre, Stephanolithion ?speciosum Deflandre, *Tubirhabdus patulus Prins ex Rood et al., Watznaueria britannica (Stradner), W.fossacincta (Black).
* reworked Lower Jurassic coccoliths.

PALYNOMORPHS (JBR)
Spores: Cyathidites australis Couper, C.minor Couper, Concavimmisisporites verrucosus Delcourt and Sprumont, Gleicheniidites senonicus Ross, Ischyosporites variegatus (Couper) Schulz, ?Lycopodiacites cerniidites (Ross) Brenner, Staplinisporites caminus (Balme) Pocock, Tripartita variabilis Maljavkina.
Pollen: Alisporites thomasii (Couper) Pocock, Alisporites Daugherty sp., Callialasporites dampieri (Balme) Sukh Dev, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson, Classopollis classoides Pflug, Cycadopidites (Woodhouse) Wilson and Webster sp., Perinopollenites elatoides Couper, Podocarpidites Cookson ex Couper.
Dinoflagellate cysts: Acanthaulax venusta (Klement) Sarjeant, Apteodinium Eisenack sp., Cribroperidinium globatum group (Gitmez and Sarjeant) Helenes, Ellipsoidictyum gochtii Fensome, Escharisphaeridia Erkmen and Sarjeant sp., Gonyaulacysta helicoidea (Eisenack and Cookson)Sarjeant, G.jurassica adecta Sarjeant, G.jurassica jurassica

(Deflandre) Norris and Sarjeant, G.jurassica jurassica var. longicornuta Sarjeant, ?Korystocysta Woollam sp., Leptodinium arcuatum Klement, Leptodinium subtile Klement, Medicodinium groenlandicum (Pocock and Sarjeant) Davey, Pareodinia ceratophora Deflandre, Rhynchodiniopsis cladophora (Deflandre) Below, Sentusidinium Sarjeant and Stover sp., skolochorate cyst indet., Stephanelytron caytonense Sarjeant, Systematophora areolata Klement, Tubotuberella dangeardii (Sarjeant) Stover and Evitt.
Acritarchs: Micrhystridium fragile Deflandre, Micrhystridium Deflandre sp..
Misc.: Botryococcus Kutzing sp., foraminiferal test linings.

Comments
The presence of G.jurassica adecta, G.jurassica jurassica, L.arcuatum and C.globatum group, indicates a late Oxfordian age. The assemblage is diverse and well-preserved with gymnosperm pollen and foraminifera test linings particularly abundant. Marine and terrestrially derived forms suggest an open-marine environment.

Sample D39 (Ringstead Waxy Clay, mid Bed 24 Arkell; rosenkrantzi Zone marstonense Subzone)

FORAMINIFERA (PC)
Dentalina sp., Lenticulina muensteri, Vaginulina glabra (d'Orbigny).

OSTRACODA (NGF)
Galliaecytheridea postrotunda Oertli, Schuleridea triebeli (Steghaus).
Samples from the Ringstead Waxy Clay have yielded a total fauna of 30 species. Most important are:
Amphicythere pennyi Kilenyi, Amphicythere sphaerulata Kilenyi, Cytherella fullonica Jones and Sherborn, Cytherelloidea paraweberi, Dicrorygma (Orthorygma) Christensen spp., Galliaecytheridea spp. (9 spp.), Hekistocythere Bate spp., Mandelstamia rectilinea Malz, Paranotacythere (Unicosta) nealei Bassiouni, Paranotacythere (Unicosta) extendata Bassiouni.

CALCAREOUS NANNOFOSSILS (PRB)
*Axopodorhabdus atavus (Grun et al.) Bown, A.cylindratus (Noel) Wind and Wise in Wise and Wind, Biscutum dubium (Noel) Grun in Grun et al., *B.finchii Crux, *B.intermedium Bown, *B.novum (Goy) Bown, *Bussonius prinsii (Noel) Goy, *Carinolithus superbus (Deflandre) Prins in Grun et al., *Crepidolithus cavus Rood et al., *C.crassus (Deflandre) Noel, *Crucirhabdus primulus Prins ex Rood et al., *Discorhabdus criotus Bown, D.ignotus (Gorka) Perch-Nielsen, D.jungi Noel, D.patulus (Deflandre) Noel, *Lotharingius hauffii Grun and Zweili in Grun et al., *L.sigillatus (Stradner) Prins in Grun et al., *Mitrolithus elegans Deflandre, *M.jansae (Wiegand) Bown and Young in Young et al., Octopodorhabdus decussatus (Manivit) Rood et al., *Parhabdolithus liasicus Deflandre, *Schizosphaerella punctulata Deflandre and Dangeard, Sollasites sp., Staurolithites sp., Stephanolithion bigotii Deflandre, S.speciosum Deflandre, Tubirhabdus patulus Prins ex Rood et al., Watznaueria barnesae (Black) Perch-Nielsen, W.britannica (Stradner), W.fossacinta (Black), Zeugrhabdotus erectus (Deflandre) Reinhardt. * reworked Lower Jurassic coccoliths.

Comments
Diverse assemblage including a large proportion of reworked Lower Jurassic taxa. The presence of coccoliths with proven ranges restricted to the Lower Jurassic is obviously due to reworking. However, a number of Lower Jurassic forms e.g. C.crassus and S.punctulata have uncertain upper ranges and this must be, to some extent, a result of their blocky, resistant structures which are most likely to survive reworking.

PALYNOMORPHS (JBR)
Spores: Concavissimisporites verrucosus Delcourt and Sprumont, Cyathidites australis Couper, C.concavus (Bolkhovitina) Dettmann, C.minor Couper, Ichyosporites variegatus (Couper) Schulz, Ichyosporites Balme sp., Leptolepidites rotundus Tralau, Obtusisporis juncta (Kara-Murza) Pocock, spore indet., ?Todisporites minor Couper, Uvaesporites Doring sp..
Pollen: Alisporites thomasii (Couper) Pocock, Alisporites Daugherty, sp., Araucaricites australis Cookson, Callialasporites dampieri (Balme) Sukh Dev, C.microvelatus Schulz, C.turbatus (Balme) Schulz, Cerebropollenites (Potonie and Venitz) Nilsson sp., Classopollis classoides Pflug, Eucommiidites troedssonnii Erdtman, Spheripollenites scabratus Couper.
Dinoflagellate cysts: Ctenidodinium Deflandre sp., ?Epiplosphaera Klement sp., dinoflagellate cyst indet., Glossodinium dimorphum Ioannides et al., ?Leptodinium Klement sp., Pareodinia ceratophora Deflandre, Rhynchodiniopsis cladophora (Deflandre) Below, Systematophora areolata Klement, Valensiella ovulum (Deflandre) Eisenack.
Acritarchs: Caddasphaera halosa (Filatoff) Fenton et al., Micrhystridium fragile Deflandre.
Prasinophycean algae: Tasmanites Newton sp.
Misc.: foraminiferal test linings.

Comments
The presence of G.dimorphum indicates an age no older than Middle Oxfordian.

Osmington Mills to Ringstead Bay (SY 73508165-SY 74408135) (fig.9)

Classic exposure of Corallian facies (Arkell, 1936, 1947).

Sample D40 (Nothe Clay, 1m below top; densiplicatum Zone, maltonense Subzone)

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Lenticulina muensteri.

OSTRACODA (NGF)
Macrodentina (Macrodentina) tenuistriata Malz.

Comments
Sample also contained various unidentified juveniles, probably of Galliaecytheridea spp.. Comments otherwise apply from the other Nothe Clay samples (D35-37).

CALCAREOUS NANNOFOSSILS (PRB)
No nannofossils recovered.

PALYNOMORPHS (JBR)
Spores: Concavissimisporites verrucosus Delcourt and Sprumont, Cyathidites minor Couper, Dictyophyllidites Couper sp., Retitriletes austroclavatidites (Cookson) Schulz et al..
Pollen: Alisporites robustus Rouse, Alisporites Daugherty sp., Cerebropollenites mesozoicus (Couper) Nilsson, Classopollis classoides Pflug, Perinopollenites elatoides Couper.
Dinoflagellate cysts: ?Cassiculosphaeridia Davey sp., Chytroeisphaeridia cerastes Davey, Ellipsoidictyum Klement sp., Endoscrinium luridum (Deflandre) Gocht, Escharisphaeridia Erkmen and Sarjeant sp., Gonyaulacysta jurassica jurassica (Deflandre) Norris and Sarjeant, Mendicodinium groenlandicum (Pocock and Sarjeant) Davey, Pareodinia ceratophora Deflandre, Rhynchodiniopsis cladophora (Deflandre) Below, Sentusidinium creberbarbatum Erkmen and Sarjeant, Sentusidinium Sarjeant and Stover sp., Systematophora areolata Klement, Tubotuberella apatela (Cookson and Eisenack) Ioannides et al., Valensiella vermiculata Gocht.
Acritarchs: Micrhystridium Deflandre sp.
Misc.: foraminiferal test linings.

Comments
The presence of E.luridum (Middle Oxfordian - Lower Kimmeridgian) with C.cerastes suggests a Middle Oxfordian age. Open marine environment.

Sample D41 (Osmington Oolite Formation, Littlemore Clay Member, Bed 5 Arkell, 1.65m below top; tenuiserratum Zone, tenuiserratum Subzone)

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Citharina serratocostata (Guembel), Dentalina pseudocommunis, Lenticulina muensteri, Planularia protracta (Bornemamm), Vaginulina anomala sensu Gordon, 1965.

Comments
V.anomala is particularly characteristic of the Osmington Oolite Series (Gordon, 1965).

OSTRACODA (NGF)
?Eocytheropteron sp. (?E. aff. purum Schmidt), Hekistocythere osmingtonensis Fuller (MS.), Macrodentina (Macrodentina) tenuistriata Malz, Pleurocythere sp., Procytherura tenuicostata Whatley, Procytherura sp., Pseudocythere spp., Terquemula multicostata (Oertli).

CALCAREOUS NANNOFOSSILS (PRB)
*Biscutum intermedium Bown, *B.novum (Goy) Bown, *Calyculus sp., *Crepidolithus cavus Rood et al., *C.crassus (Deflandre) Noel, Cyclagelosphaera margereli Noel, *Discorhabdus criotus Bown, D.ignotus (Gorka) Perch-Nielsen, D.patulus (Deflandre) Noel, Lotharingius crucicentralis (Medd) Grun and Zweili, *L.hauffii Grun and Zweili in Grun et al., *L.sigillatus (Stradner) Prins in Grun et al., *Mitrolithus elegans Deflandre, M.jansae (Wiegand) Bown and Young in Young et al., *Parhabdolithus liasicus Deflandre, Schizosphaerella punctulata Deflandre and Dangeard, Stephanolithion bigotii Deflandre, Stephanolithion speciosum Deflandre, Tubirhabdus patulus Prins ex Rood et al., Watznaueria barnesae (Black)

Perch-Nielsen, W.britannica (Stradner), W.fossacinta (Black), W.strigosa (Grun and Zweili), Zeugrhabdotus erectus (Deflandre) Reinhardt. * reworked Lower Jurassic coccoliths.

PALYNOMORPHS (JBR)
Spores: Cyathidites australis Couper, C.minor Couper, Dictyophyllidites Couper sp., Retitriletes austroclavatidites (Cookson) Schulz et al., R.semimuris (Danze-Corsin and Laveine) MacKellar, spore indet., Todisporites minor Couper.
Pollen: Alisporites robustus Rouse, A.thomasii (Couper) Pocock, Alisporites Daugherty sp., Callialasporites dampieri (Balme) Sukh Dev, C.microvelatus Schulz, Cerebropollenites mesozoicus (Couper) Nilsson, Classopollis classoides Pflug, Perinopollenites elatoides Couper, Podocarpidites Cookson, 1947 ex Couper, Spheripollenites psilatus Couper.
Dinoflagellate cysts: Cleistosphaeridium? tribuliferum (Sarjeant) Davey et al., Cribroperidinium globatum group (Gitmez and Sarjeant) Helenes, Ctenidodinium chondrum Drugg, Ctenidodinium ornatum (Eisenack) Deflandre, Ctenidodinium Deflandre sp., dinoflagellate cyst indet., ?Dissiliodinium Drugg sp., Ellipsoidictyum Klement sp., Endoscrinium luridum (Deflandre) Gocht, Escharisphaeridia Erkmen and Sarjeant sp., Mendicodinium groenlandicum (Pocock and Sarjeant) Davey, Pareodinia ceratophora Deflandre, Sentusidinium creberbarbatum Erkmen and Sarjeant, S.rioultii (Sarjeant) Sarjeant and Stover, Sentusidinium Sarjeant and Stover sp., Stephanelytron redcliffense Sarjeant, Systematophora areolata Klement, Tubotuberella apatela (Cookson and Eisenack) Ioannides et al..
Acritarch: Caddasphaera halosa (Filatoff) Fenton et al..
Misc.: foraminiferal test linings.

Sample D42 (Osmington Oolite Formation, Bed 8 Arkell, 2m below top; tenuiserratum Zone)

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Citharina serratocostata (Guembel), Dentalina bicornis Terquem, Dentalina pseudocommunis, Lenticulina muensteri, Lenticulina varians (Bornemann), Planularia protracta (Bornemamm), Vaginulina anomala sensu Gordon, 1965, V.pasquetae.

OSTRACODA (NGF)
Galliaecytheridea posterospinosa Fuller (MS.), G.postrotunda Oertli, small Procytheropteron sp., Procytherura tenuicostata Whatley.
The following species also occur in this bed:
Macrodentina (Macrodentina) tenuistriata, M.(Macrodentina) whatleyi Kilenyi, Pseudohutsonia tuberosa Wienholz (Dorset form), Pseudocythere spp..

Comments
Sample dominated by G.posterospinosa.

CALCAREOUS NANNOFOSSILS (PRB)
Crepidolithus crassus (Deflandre) Noel, Cyclagelosphaera margereli Noel, *Lotharingius sigillatus (Stradner) Prins in Grun et al., *Parhabdolithus liasicus Deflandre, Stephanolithion bigotii Deflandre, Watznaueria britannica (Stradner), W.fossacincta (Black), W.ovata (Bukry). * reworked Lower Jurassic taxa.

PALYNOMORPHS (JBR)
Spores: Auritulinasporites scanicus Nilsson, Concavimmisisporites verrucosus Delcourt and Sprumont, Cyathidites australis Couper, C.minor Couper, Dictyophyllidites harrissii Couper, Osmundacidites Couper sp., spore indet..
Pollen: Alisporites thomasii (Couper) Pocock, Callialasporites dampieri (Balme) Sukh Dev, C.microvelatus Schulz, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson, Cycadopidites nitidus (Balme) Pocock, Perinopollenites elatoides Couper.
Dinoflagellate cysts: Chytroeisphaeridium chytroeides (Sarjeant) Downie and Sarjeant, Cribroperidinium globatum group (Gitmez and Sarjeant) Helenes, C.granulatum (Klement) Stover and Evitt, ?Dissiliodinium Drugg sp., gonyaulacoid indet., Sentusidinium creberbarbatum Erkmen and Sarjeant, Tubotuberella dangeardii (Sarjeant) Stover and Evitt.
Acritarch: Micrhystridium Deflandre sp..
Prasinophycean algae: Tasmanites Newton sp..

Sample D43 (Osmington Oolite Formation, Bed 10 Arkell, tenuiserratum Zone)

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Citharina serratocostata, Lenticulina muensteri, Lenticulina varians, Vaginulina pasquetae.

OSTRACODA (NGF)
Galliaecytheridea posterospinosa Fuller (MS.), Macrodentina (Macrodentina) tenuistriata Malz, Macrodentina (Macrodentina) whatleyi Kilenyi, Pseudohutsonia tuberosa Wienholz (Dorset form), Schuleridea sp..

Comments
P.tuberosa is clearly identifiable but appears to possess a different surface ornament (smooth as opposed to reticulate) to specimens from Normandy and northern England. This may reflect subtle environmental differences hence these specimens are loosely referred to as "Dorset form". As with other samples at this level various small Procytherura and Pseudocythere can be expected.

CALCAREOUS NANNOFOSSILS (PRB)
Crepidolithus crassus (Deflandre) Noel, Cyclagelosphaera margereli Noel, Stephanolithion bigotii Deflandre, Watznaueria barnesae (Black) Perch-Nielsen, W.britannica (Stradner), W.fossacincta (Black).

PALYNOMORPHS (JBR)
Spores: Cyathidites australis Couper, Densoisporites (Weyland and Krieger) Dettmann sp., Gleicheniidites senonicus, Ischyosporites variegatus (Couper) Schulz, Retitriletes (Pierce) Doring et al. sp..
Pollen: Alisporites thomasii (Couper) Pocock, Alisporites Daugherty sp., Callialasporites microvelatus Schulz, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson, Cycadopidites nitidus (Balme) Pocock, Perinopollenites elatoides Couper, Podocarpidites Cookson, ex Couper sp..
Dinoflagellate cysts: Chytroeisphaeridium chytroeides (Sarjeant) Downie and Sarjeant, Cleistosphaeridium Davey et al. sp., ?Cribroperidinium globatum group (Gitmez and Sarjeant) Helenes, C.granulatum (Klement) Stover and Evitt, Cribroperidinium Neale and Sarjeant sp., Dichadogonyaulax? filipicata (Gocht) Jan du Chene et al.,

Endoscrinium galeritum (Deflandre) Vozzhennikova, Ellipsoidictyum cinctum Klement, Escharisphaeridium Erkmen and Sarjeant sp., Leptodinium subtile Klement, Pareodinia ceratophora Deflandre, Rhynchodiniopsis cladophora (Deflandre) Below, Sentusidinium creberbarbatum Erkmen and Sarjeant, Sentusidinium Sarjeant and Stover sp., Systematophora areolata Klement, Systematophora penicillata (Ehrenberg) Sarjeant, Systematophora Klement sp., Valensiella Eisenack sp..
Acritarchs: Caddasphaera halosa (Filatoff) Fenton et al., Micrhystridium fragile Deflandre, Micrhystridium Deflandre sp..
Prasinophycean algae: Tasmanites Newton sp.
Misc.: foraminiferal test linings.

Comments
C.globatum and R.aemula indicate a Middle/Upper Oxfordian age. Open marine environment.

Sample D44 (Trigonia clavellata Beds Formation, The Sandy Block Member, Bed 13 Arkell, 1.7m above base; glosense Zone, ilovaiskii Subzone)

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Lenticulina muensteri, Planularia sp., Vaginulina pasquetae.

OSTRACODA (NGF)
Galliaecytheridea posterospinosa Fuller (MS.), Galliaecytheridea ventrocaudata Fuller, Macrodentina (Macrodentina) whatleyi Kilenyi, Mandelstamia rectilinea Malz, Pseudohutsonia tuberosa Wienholz (Dorset form), Schuleridea triebeli (Steghaus), Vernoniella saquana Oertli.
The following species also occur in this unit:
Amphicythere pennyi Kilenyi, Cytherelloidea paraweberi Oertli, Galliaecytheridea confundens Kilenyi, G.dissimilis Oertli, Macrodentina (Macrodentina) cicatricosa Malz, Schuleridea grossipunctata Fuller (MS.), Terquemula multicostata (Oertli).

Comments
Small numbers of other Galliaecytheridea species (previously undescribed) begin to appear at this level.

CALCAREOUS NANNOFOSSILS (PRB)
Biscutum dubium (Noel) Grun in Grun et al., Crepidolithus crassus (Deflandre) Noel, Discorhabdus sp., *Lotharingius sigillatus (Stradner) Prins in Grun et al., *Parhabdolithus liasicus Deflandre, *Schizosphaerella punctulata Deflandre and Dangeard, Stephanolithion speciosum Deflandre, Stradnerlithus asymmetricus (Rood et al.) Medd, Tubirhabdus patulus Prins ex Rood, Watznaueria britannica (Stradner), W.fossacinta (Black), W.plena (Grun and Zweili), Zeugrhabdotus erectus (Deflandre) Reinhardt. * reworked Lower Jurassic coccoliths.

PALYNOMORPHS (JBR)
Spores: Cyathidites australis Couper, Cyathidites minor Couper, ?Ischyosporites Balme sp., Murospora Somers sp., Retitriletes austroclavatidites (Cookson) Schulz et al., R.semimuris (Danze-Corsin and Laveine) MacKellar.

Pollen: Alisporites thomasii (Couper) Pocock, Alisporites Daugherty sp., Callialasporites dampieri (Balme) Sukh Dev, C.microvelatus Schulz, C.turbatus (Balme) Schulz, Cerebropollenites mesozoicus (Couper) Nilsson, Classopollis classoides Pflug, Spheripollenites psilatus Couper, Vitreosporites pallidus (Reissinger) Nilsson.
Dinoflagellate cysts: ?Apteodinium Eisenack sp., Cribroperidinium granulatum (Klement) Stover and Evitt, Ctenidodinium sellwoodii (Sarjeant) Stover and Evitt, Escharisphaeridia Erkmen and Sarjeant sp., Glossodinium dimorphum Ioannides et al., Gonyaulacysta helicoidea (Eisenack and Cookson) Sarjeant, G.jurassica jurassica (Deflandre) Norris and Sarjeant, gonyaulacoid cyst indet., Leptodinium cf. subtile Klement, Mendicodinium groenlandicum (Pocock and Sarjeant) Davey, Nannoceratopsis pellucida Deflandre, Sentusidinium creberbarbatum Erkmen and Sarjeant, Systematophora areolata Klement, Systematophora Klement sp., Tubotuberella dangeardii (Sarjeant) Stover and Evitt.
Acritarchs: Micrhystridium Deflandre sp..
Prasinophycean algae: Tasmanites Newton sp..
Misc.: foraminiferal test linings.

Comments
The presence of G.dimorphum together with N.pellucida indicates a Middle/Upper Oxfordian age; further evidence being the absence of large numbers of the C.globatum complex.

Sample D45 (Trigonia clavellata Beds Formation, The Clay Band Member, Bed 15 Arkell; glosense Zone, glosense Subzone)

FORAMINIFERA (PC)
Ammobaculites coprolithiformis, Citharina implicata (Schwager), C.serratocostata, Dentalina bicornis, Haplophragmoides canui, Lenticulina muensteri, Planularia tricarinella (Reuss).

Comments
The occurrence of C.implicata appears anomalously high, previous records indicating an age no younger than earliest Oxfordian (mariae Zone) (Shipp and Murray 1981). The last occurrence of A.coprolithiformis marks a position near the top of the Oxfordian in Dorset (Medd 1982). H.canui contains a variant with Recurvoides-like (streptospiral) early coiling. This is characteristic of H.canui populations and such variants have been referred to as Recurvoides obskiensis Dain.

OSTRACODA (NGF)
Galliaecytheridea postrotunda, ?Pleurocythere oxfordiana, Schuleridea triebeli, Terquemula multicostata, Vernoniella caletorum, V.sequana.
The following species also occur in this unit:
Galliaecytheridea cf. G.mandelstami, Macrodentina (Polydentina) proclivis Malz, Nophrecythere cruciata oxfordiana, Procytheroptheron cryptica Fuller.

Comments
The ?Pleurocythere genus has been referred in the past to Anderson's identification of Protocythere Triebel, but appears more suitable to be included in Pleurocythere Triebel. Species of this genus in this part of the section commonly show features apparently transitional between

Pleurcythere (essentially Middle/Upper Jurassic) and Protocythere (essentially Upper Jurassic/Lower Cretaceous).

CALCAREOUS NANNOFOSSILS (PRB)
Cyclagelosphaera margereli, Watznaueria ovata.

PALYNOMORPHS (JBR)
Spores: Concavimmisisporites verrucosus, Cyathidites australis, C.concavus (Bolkhovitina) Dettman, C.minor, Densoisporites sp., Ischyosporites variegatus, Lycopodiacidites cerniidites, Lycopodiumsporites austroclavatidites.
Pollen: Alisporites thomasii, A. sp., Araucaricites australis, Callialasporites dampieri, C.microvelatus, C.trilobatus, C.turbatus, Cerebropollenites mesozoicus, Classopollis classoides, Cycadopodites nitidus, Perinopollenites elatoides, Spheripollenites psilatus.
Dinoflagellate cysts: Acanthaulax venusta (Klement) Sarjeant, Apteodinium cf. A.granulatum, Cleistosphaeridium? tribuliferum, Compositosphaeridium polonicum, Cribroperidinium sp., Ctenidodinium ornatum, ?Dissiliodinium Drugg sp., ?Ellipsoidictyum cinctum, Escharisphaeridia sp., Gonyaulacysta jurassica jurassica, Mendicodinium groenlandicum, Pareodinia ceratophora, Sentusidinium sp., Stephanelytron recliffenses, Systematophora areolata.
Acritarchs: Micrhystridium fragile.
Misc.: foraminiferal test linings.

Comments
The presence of C.ornatum, A. cf. granulatum and Cribroperidinium sp. indicates a Middle - Upper Oxfordian age. Bisaccate pollen (principally Alisporites spp.) very common.

Kimmeridge and Worth Martravers area

The Kimmeridge Clay has attracted great interest as a consequence of its rich ammonite assemblages and unusual lithologies, and especially so in recent years when its significance as a major source rock has come to be recognised. The dominant lithology is of organic rich shales with Total Organic Carbon figures of some 20%, and in places coccolith limestones occur reflecting extraordinary productivity. These phenomena have attracted attention to the oceanographic conditions under which the Kimmeridge Clay was formed (Gallois 1976, Gallois and Medd 1979, Tyson et al. 1979).

At Kimmeridge Bay (SY 906790) (fig.10), the stage stratotype for the Kimmeridgian, the base of the formation is not seen although it can be

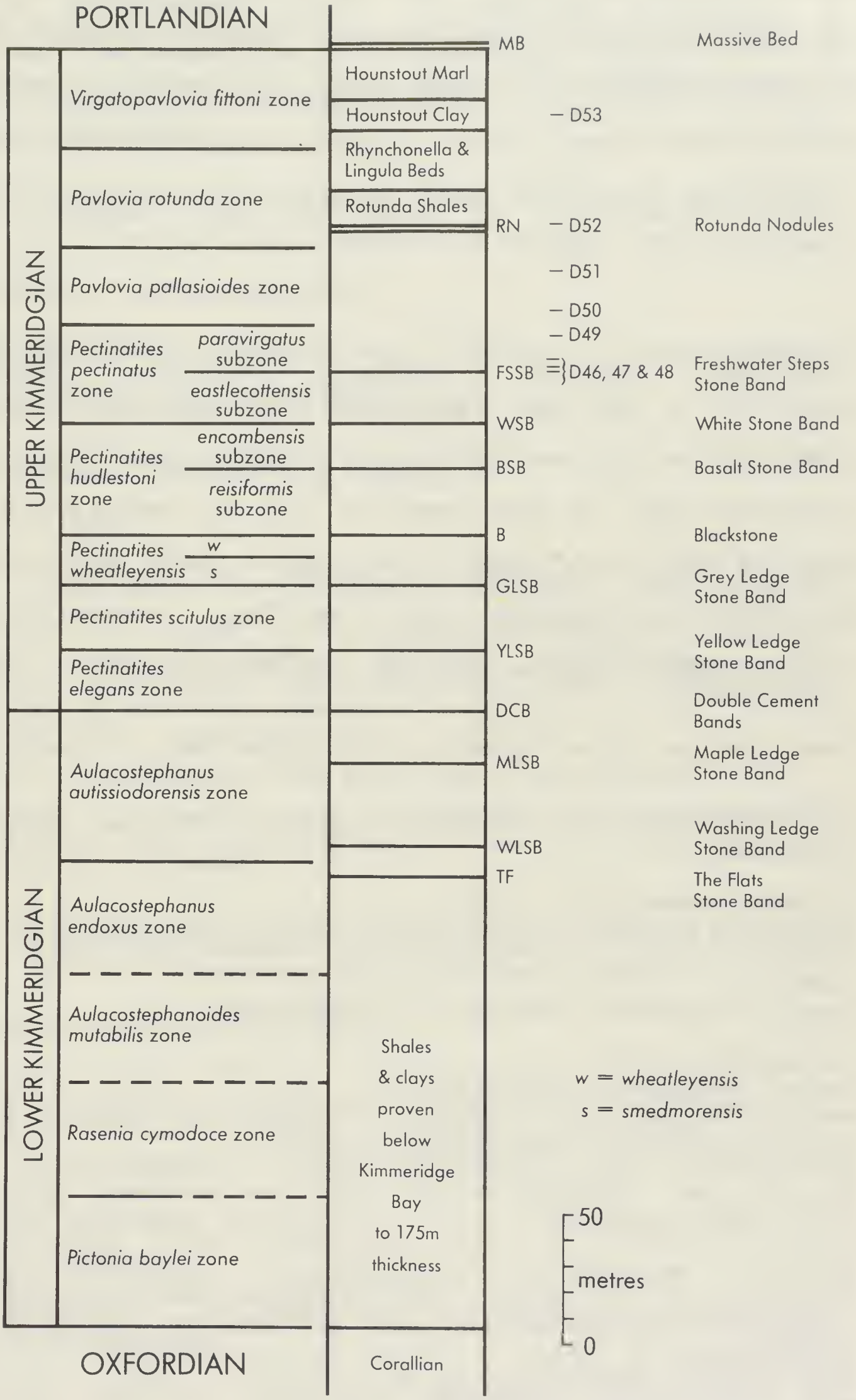


Fig. 10. Lithostratigraphy of the Kimmeridgian in the Kimmeridge area. (After Cope et al. 1980b).

studied at Black Head (q.v.); some 175m of shales and clays to the top of the Corallian have been penetrated in an industrial borehole in the bay. The beds exposed are of upper Lower Kimmeridgian age (eudoxus and autissiodorensis Zones) and lack calcareous benthic organisms. The area is a reserve and therefore no samples collected. The Kimmeridge Clay in the type area is 500m thick.

Calcareous benthic microfossils are absent or very rare throughout the upper part of the Lower Kimmeridgian and lower part of the Upper Kimmeridgian of this area to the level of the Freshwater Steps Stone Band (pectinatus Zone). The Upper Kimmeridge Clay was sampled from Freshwater Steps (SY 95707705) to Chapman's Pool. Samples D46-48 were collected in and around the Freshwater Steps Stone Band, a distinctive coccolith limestone; D46 and D48 are from light coloured, coccolith-rich levels.

Sample D46 (1m below Freshwater Steps Stone Band, in Bed 11 of Blake Cope 1967, p.7); pectinatus Zone, eastlecottensis Subzone)

No FORAMINIFERA or OSTRACODA recovered - presumed anoxic bottom conditions.

CALCAREOUS NANNOFOSSILS (PRB)
Watznaueria barnesae, W.biporta Bukry, W.fossacincta, W.strigosa.

Comments
Very rich assemblage, dominated by W.fossacincta.

PALYNOMORPHS (JBR)
Spores: Uvaesporites argenteaeformis.
Pollen: Alisporites thomasii, Classopollis classoides, Spheripollenites psilatus, Vitreosporites pallidus.
Dinoflagellate cysts: Acanthaulax venusta, Cribroperidinium globatum, Ctenidodinium? panneum (Norris) Lentin and Williams, Epiplosphaeara sp., Escharisphaeridia sp., Glossodinium dimorphum, Gochteodinia mutabilis (Riley in Fisher and Riley) Davey, Hystrichosphaerina orbifera, Mendicodinium groenlandicum, Pareodinia ceratophora, ?Scriniodinium inritibilium Riley in Fisher and Riley, Senoniasphaera jurassica (Gitmez and Sarjeant) Lentin and Williams, Sentusidinium sp., Systematophora sp.I Davey.
Prasinophycean algae: Tasmanites sp.
Misc.: foraminiferal test linings.

Comments
The presence of S.jurassica indicates an age no older than Upper

Kimmeridgian (wheatleyensis Zone). The additional occurrence of C.?panneum suggests a definite Upper Kimmeridgian age (pectinatus - fittoni Zone). The Kimmeridgian is characterised by high levels of amophogen. Residue dominated by large amounts of amorphous sapropel - typical of Kimmeridge Clay. Marine and terrestrially-derived forms infer an open-marine environment.

Sample D47 (Freshwater Steps Stone Band, Bed 10 of Blake (Cope 1967, p.7); pectinatus Zone, paravirgatus Subzone)

No FORAMINIFERA or OSTRACODA recovered.

CALCAREOUS NANNOFOSSILS (PRB)
Polypodorhabdus escaigi, Watznaueria barnesae, W.biporta, W.britannica, W.fossacincta, W.strigosa.

Comments
Very rich assemblage dominated by W.fossacincta.

PALYNOMORPHS (JBR)
Spores: spore indet..
Pollen: Alisporites sp., Classopollis classoides, Spheripollenites sp..
Dinoflagellate cysts: cyst indet., Glossodinium dimorphum, gonyaulacoid cyst indet., Hystrichosphaerina orbifera, Meiourogonyaulax sp., ?Scriniodinium inritibilium, skolochorate cyst indet., Systematophora cf. S.areolata, S. sp.I Davey, Tubotuberella apatela.
Prasinophycean algae: Tasmanites sp.

Comments
Systematophora sp.I together with G.dimorphum indicates a Kimmeridgian - mid-Portlandian age. Sparse residue in terms of palynomorphs but sapropelic matter very common.

Sample D48 (1.75m above Freshwater Steps Stone Band, Bed 9 of Blake (Cope 1967, p.7); pectinatus Zone, paravirgatus Subzone)

No FORAMINIFERA or OSTRACODA recovered.

CALCAREOUS NANNOFOSSILS (PRB)
Watznaueria barnesae, W.biporta, W.britannica, W.fossacincta, W.strigosa.

Comments
As D47.

PALYNOMORPHS (JBR)
Spores: Retitriletes austroclavatidites.
Pollen: Alisporites thomasii, A. sp., Classopollis classoides, Perinopollenites elatoides.
Dinoflagellate cysts: Apteodinium sp., Cribroperidinium sp., Ctenidodinium? panneum, Dingodinium tuberosum (Gitmez) Fisher and Riley, Glossodinium dimorphum, Hystrichosphaerina orbifera, Hystrichodinium pulchrum Deflandre, Leptodinium subtile, Mendicodinium groenlandicum, Scriniodinium inritibilium, Senoniasphaera jurassica, Systematophora areolata, S.penicillata,

S. sp.I, Tubotuberella apatela.
Acritarchs: Micrhystridium sp..
Prasinophycean algae: Tasmanites sp..
Misc.: foraminiferal test linings.

Comments
C.panneum and S.inritibilium indicate a late Kimmeridgian to basal Portlandian age. High levels of amorphous sapropel and common Tasmanites sp..

Sample D49 (Bed 6b of Blake (Cope 1978, p.472); pectinatus Zone, paravirgatus Subzone)

FORAMINIFERA (PC)
Ammobaculites deceptorius (Haeusler), Citharina heteropleura (Terq), C.serratocostata, Eoguttulina sp., Lenticulina muensteri subalata (Reuss), L.varians, Marginulina fragraria (Gumbel), M. sp.1, Marginulinopsis costata (Batsch), Saracenaria oxfordiana Tappan.

OSTRACODA (NGF)
Dicrorygma (Orthorygma) kimmeridgensis (Kilenyi), Galliaecytheridea ?trapezoidalis Kilenyi, Macrodentina (Polydentina) proclivis ?striata Kilenyi, Monoceratina sp.1, ?Pseudocythere oblonga.

CALCAREOUS NANNOFOSSILS (PRB)
Watznaueria fossacincta.

PALYNOMORPHS (JBR)
Spores: Cicatricosisporites Potonie & Gelletich sp., Cyathidites australis, C.minor.
Pollen: Alisporites sp., Classopollis classoides, Spheripollenites sp..
Dinoflagellate cysts: Cyclonephelium hystrix (Eisenack) Davey, Dingodinium tuberosum, Escharisphaeridia sp., Leptodinium arcuatum, Occisucysta balios Gitmez, Sentusidinium sp., Systematophora sp..
Prasinophycean algae: Tasmanites sp.

Comments
The presence of O.balios and D.tuberosum together with L.arcuatum indicates a Kimmeridgian age.

Sample D50 (Bed 3b of Blake (Cope 1978, p.427), 0.5m above base; pallasioides Zone)

FORAMINIFERA (PC)
Ammobaculites deceptorius, Citharina heteropleura, Cyclogyra liasina/Spirillina tenuissima (pyritised casts), Dentalina sp., Eoguttulina sp., Haplophragmoides kingakensis Tappan, Lenticulina muensteri, L.muensteri subalata, L.varians, Marginulina costata, M.fragraria, M.fragraria var. hispid, Planularia protracta, Pseudonodosaria vulgata (Bornemann). Saracenaria cornucopiae (Schuager).

OSTRACODA (NGF)
Eocytheropteron decoratum (Schmidt), Paranotacythere (Unicosta) sp.?

Bassiouni, ?Psedocythere oblonga.

CALCAREOUS NANNOFOSSILS (PRB)
Ethmorhabdus gallicus, Polypodorhabdus escaigi, Watznaueria barnesae, W.britannica, W.fossacincta, W.reinhardtii, W.strigosa, Zeugrhabdotus erectus.

PALYNOMORPHS (JBL)
Spores: Cicatricosisporites sp., Cyathidites minor.
Pollen: Alisporites thomasii, A. sp., Callialasporites turbatus, Chasmatosporites sp., Classopollis classoides, Perinopollenites elatoides.
Dinoflagellate cysts: Acanthaulax venusta, Ctenidodinium? panneum, Cyclonephelium hystrix, Dingodinium tuberosum, Escharisphaeridia sp., Glossodinium dimorphum, Gonyaulacysta helicoidea, Hystrichodinium pulchrum, Occisucysta balios, Pareodinia ceratophora, Prolixsphaeridium granulosum (Deflandre) Davey et al., Sentusidinium sp., skolochorate cyst indet., Systematophora sp..
Prasinophycean algae: Tasmanites sp..
Misc.: foraminiferal test linings.

Comments
The presence of O.balios, D.tuberosum and C.?panneum in particular indicate a late Kimmeridgian/early Portlandian age. Amorphogen common.

Sample D51 (Bed 3f of Blake (Cope 1978, p.427); pallasioides Zone SY 84757730)

FORAMINIFERA (PC)
Ammobaculites alaskensis Tappan, A.barrowensis Tappan, Citharina serratocostata, Lenticulina muensteri subalata, Marginulina sp.1, Marginulinopsis costata, Saracenaria cornucopiae (Schuager), S.oxfordiana.

OSTRACODA (NGF)
Dicrorygma (Orthorygma) kimmeridgensis, Paranotacythere (Unicosta) sp.? Bassiouni, ?Psedocythere oblonga.

CALCAREOUS NANNOFOSSILS (PRB)
Watznaueria britannica, W.fossacincta, W.ovata.

PALYNOMORPHS (JBR)
Spores: Cicatricosisporites sp., Gleicheniidites senonicus, Ischyosporites variegatus, Retitriletes semimuris, Uvaesporites argenteaeformis.
Pollen: Alisporites thomasii, Cerebropollenites mesozoicus, Classopollis classoides.
Dinoflagellate cysts: Chlamydophorella cf. nyei Cookson and Eisenack, Chytroeisphaeridia chytroeides, Cleistosphaeridium? tribuliferum, Cribroperidinium globatum, C.granulatum, Ctenidodinium? panneum, Ctenododinium sp., Cyclonephelium hystrix, Egmontodinium polyplacophorum Gitmez and Sarjeant, Endoscrinium anceps Raynaud, Endoscrinium sp., Escharisphaeridia sp., Glossodinium dimorphum, Hystrichodinium pulchrum, Mendicodinium groenlandicum, Pareodinia ceratophora, Prolixosphaeridium granulosum, Rhynchodiniopsis pennata (Riley in Fisher and Riley) Jan du Chene et al., Senoniasphaera jurassica, Sentusidinium creberbarbatum, S.

sp., Systematophora areolata, S.penicillata, S. sp.I, S. sp..
Acritarchs: Caddasphaera halosa, Micrhystridium sp..
Prasinophycean algae: Tasmanites newtoni Wall.
Misc.: foraminiferal test linings.

Comments
The occurrence of R.pennata, E.polyplacophorum and C.?panneum indicates a late Kimmeridgian/early Portlandian age.

Chapman's Pool (SY 95507712)

Sample D52 (Rotunda Nodule Bed, Bed 1b of Blake (Cope 1978, p.472); rotunda Zone)

FORAMINIFERA (PC)
Lenticulina muensteri, Lingulina cernua, Marginulinopsis costata, Saracenaria oxfordiana.

Comments
The influx of S.oxfordiana is notable and may have stratigraphic value.

OSTRACODA (NGF)
Galliaecytheridae postrotunda, G.spinosa, G.trapezoidalis, ?Psedocythere oblonga.

CALCAREOUS NANNOFOSSILS (PRB)
*Crepidolithus crassus Polypodorhabdus escaigi, Watznaueria barnesae, W.britannica, W.fossacincta, W.strigosa, Zeugrhabdotus erectus. * reworked?

PALYNOMORPHS (JBR)
Spores: Cyathidites australis, C.minor, Gleicheniidites senonicus, Retitriletes austroclavatidites.
Pollen: Callialasporites turbatus, Classopollis classoides, Vitreosporites pallidus.
Dinoflagellate cysts: Chytroeisphaeridia chytroeides, Cribroperidinium globatum, Ctenidodinium? panneum, Escharisphaeridia sp., Glossodinium dimorphum, Gochteodinia cf. mutabilis, Gonyaulacysta helicoidea, Hystrichodinium pulchrum, Mendicodinium groenlandicum, Muderongia Sp.A Davey, Occisucysta balios, Pareodinia ceratophora, Prolixosphaeridium granulosum, Senoniasphaera jurassica, Sentusidinium creberbarbatum, S. sp., skolochorate cyst indet., Systematophora areolata.
Acritarchs: Micrhystridium sp..

Comments
Muderongia sp.A has a Kimmeridgian (rotunda Zone) to Portlandian (okusensis Zone) range.

Sample D53 (Hounstout Clay; fittoni Zone)

FORAMINIFERA (PC)
Lenticulina muensteri.

CALCAREOUS NANNOFOSSILS (PRB)
Polypodorhabdus escaigi, Staurolithites sp., Watznaueria britannica, W.fossacincta.

PALYNOMORPHS (JBR)
Spores: Cyathidites minor, Ischyosporites vaerigatus, Lycopodiacidites cerniidites, Retitriletes semimuris.
Pollen: Alisporites sp., Classopollis classoides, Perinopollenites elatoides, Podocarpidites sp..
Dinoflagellate cysts: Cribroperidinium globatum, Ctenidodinium? panneum, Dingodinium tuberosum, Mendicodinium groenlandicum, Muderongia Sp.A, Senoniasphaera jurassica, Sentusidinium sp..
Acritarchs: Caddasphaera halosa, Micrhystridium sp..
Prasinophycean algae: Tasmanites sp..
Misc.: foraminiferal test linings.

Isle of Portland (figs. 11 and 12)

Units representing the lower part of the Portlandian are well displayed in the Isle of Purbeck (Hounstout Cliff and St. Alban's Head, near Chapman's Pool) but were sampled on the Isle of Portland, near Tar Rocks on the western coast. The lithostratigraphy for the Portland Group erected by Townson (1975) is not followed here as the older nomenclature of Arkell (1947, etc.) is more convenient for local use. The Portland Group is 65m thick on Portland.

Sample D54 (Upper Blacknore Beds; albani Zone)

FORAMINIFERA (PC)
Lenticulina muensteri.

OSTRACODA
No ostracods recovered.

CALCAREOUS NANNOFOSSILS (PRB)
Watznaueria britannica, W.fossacincta.

PALYNOMORPHS (JBR)
Pollen: Alisporites spp., Classopollis classoides, Callialasporites turbatus.
Dinoflagellate cysts: Ctenidodinium? panneum, Dingodinium tuberosum, Escharisphaeridia sp., Glossodinium dimorphum, Sentusidinium sp..

Sample D55 (Upper Blacknore Beds; albani Zone)

FORAMINIFERA (PC)
Citharina serratocostata, Lenticulina muensteri, L.varians, Marginulinopsis costata.

Comments
The Portlandian assemblages appear to represent a continuation of those of the Kimmeridgian. Other than an isolated record of L.muensteri from the

Portland Sand (Shipp and Murray 1981), foraminifera have not previously been described from the British Portlandian.

CALCAREOUS NANNOFOSSILS (PRB)
Watznaueria britannica, W.fossacincta, W.strigosa, Staurolithites sp., Zeugrhabdotus erectus.

PALYNOMORPHS (JBR)
Spores: Cyathidites minor.
Pollen: Alisporites thomasii, circumpolles indet., Classopollis classoides, Perinopollenites elatoides.
Dinoflagellate cysts: Apteodinium sp.A, Bourkodinium Morgan sp., Cannosphaeropsis thula Davey, Cribroperidinium sp.A Davey, 1982, C. spp., Ctenidodinium? panneum, Cyclonephelium hystrix, Ellipsoidictyum cf. cinctum, ?Endoscrinium campanula, ?Exiguisphaera Duxbury sp., Glossodinium dimorphum, Gonyaulacysta eisenackii, Hystrichodinium pulchrum, Mendicodinium groenlandicum, Muderongia sp.A, Senoniasphaera jurassica, Sentusidinium sp., skolochorate cyst indet., Systematophora areolata, S.sp.I.
Acritarchs: Micrhystridium sp..
Prasinophycean algae: Tasmanites sp..
Misc.: Pterospermella Eisenack sp..

Sample D56 (Portland Clay; okusensis Zone)

FORAMINIFERA (PC)
Citharina flabelloides, C.serratocostata, Lenticulina muensteri, Seracenaria oxfordiana.

No OSTRACODA or CALCAREOUS NANNOFOSSILS recovered.

PALYNOMORPHS (JBR)
Spores: Corrugatisporites amplectiformis (Kara-Murza) Pocock, Cyathidites minor, Gleicheniidites senonicus, Leptolepidites sp., spore indet., Retitriletes semimuris.
Pollen: Alisporites thomasii, Callialasporites dampieri, Classopollis classoides, Cerebropollenites mesozoicus, Podocarpidites sp..
Dinoflagellate cysts: Apteodinium sp., Cannosphaeropsis thula, Ctenidodinium? panneum, C. sp., Egmontodinium expiratum Davey, Emmetrocysta sarjeantii (Gitmez) Stover and Evitt, ?Endoscrinium campanula, Escharisphaeridia sp., Glossodinium dimorphum, Gonyaulacysta helicoidea, Hystrichodinium pulchrum, Hystrichosphaerina orbifera, Kleithriasphaeridium porosispinum Davey, Mendicodinium groenlandicum, Prolixosphaeridium sp., Senoniasphaera jurassica, Sentusidinium sp., Systematophora areolata, S. sp.I.
Acritarchs: Micrhystridium sp..
Misc.: foraminiferal test linings.

Comments
The occurrence of E.expiratum with C.?panneum and G.dimorphum indicates an early Portlandian age. The preponderance of marine indices suggests an open-marine environment.

The Portland Cherty Beds and Portland Freestone were not sampled. The

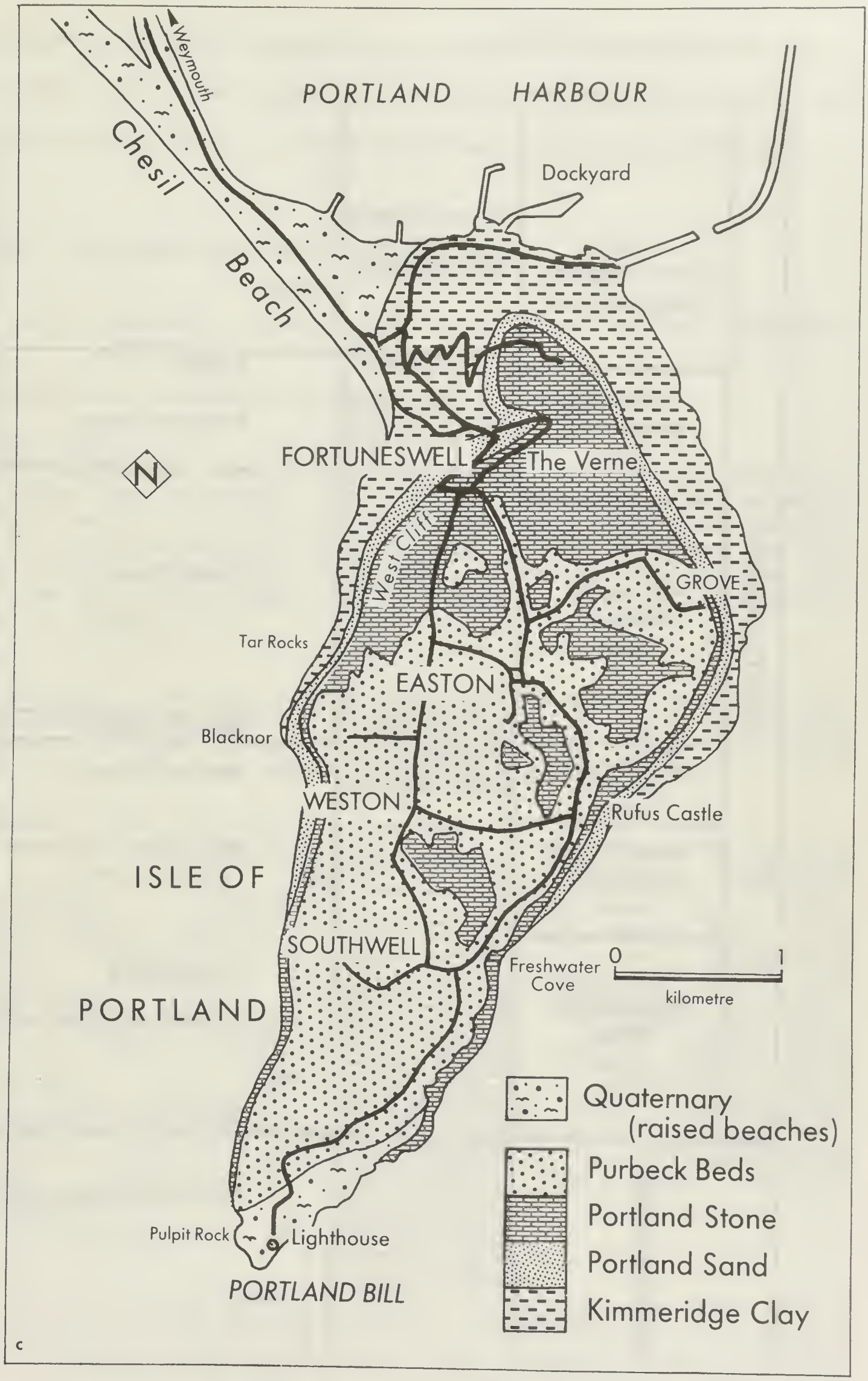


Fig. 11. Geological map of the Isle of Portland. (After Geological Survey).

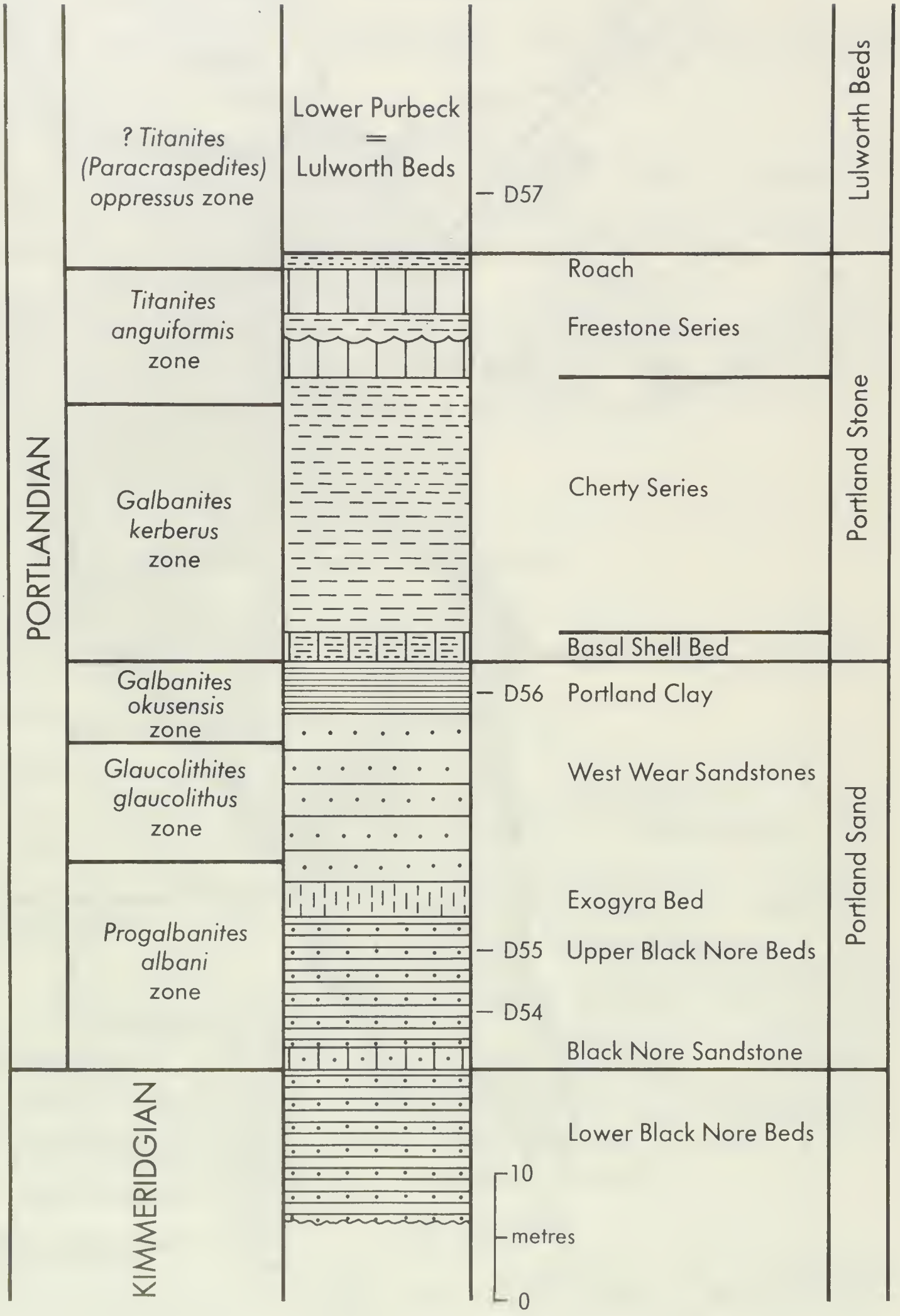


Fig. 12. Lithostratigraphy of the Portlandian of Portland. (After Arkell 1947).

"Purbeckian" is no longer recognised as a chronostratigraphic unit but is considered to fall in the later part of the Portlandian. The junction and some 35m of Purbeck Group, Lulworth Formation can be seen on Portland.

Southwell, Freshwater Cove Quarry (SY 68926987)

Sample D57 (Lowermost Lulworth Beds, clay above Aish Tier; ?oppressus Zone)

No FORAMINIFERA or CALCAREOUS NANNOFOSSILS recovered.

OSTRACODA (RGC)
Poorly preserved but abundant ostracods. Mostly crushed and/or worn/algal coated valves and carapaces. None of the specimens show in themselves sufficient detail (no internal detail seen) to be identified. However, assuming a Lower Purbeck age for the sample, the best preserved specimens are all probably Mantelliana purbeckensis (Forbes) (from shape and size alone). The others are probably mostly the same, although some (one or two) may be Fabanella sp..

Comments
M.purbeckensis is a long-ranging species (as is the genus Fabanella), but the assemblage is typical of the Lower Purbeck (sensu anglica) and is thought to have characterised near-marine salinities in enclosed lagoons ("stage 3'" of the "closed series" of Clements 1973 MS.).

PALYNOMORPHS (DJB, JKL, AMM)
Miospores: Abietineaepollenites spp., Alisporites bilateralis Rouse, Araucariacites australis, Callialasporites dampieri, C.segmentatus, C.trilobatus, C.turbatus, C. sp., Cerebropollenites mesozoicus, Cicatricosisporites abacus Burger, C. sp. cf. C.australiensis (Cookson) Potonie, C. sp., Classopollis classoides, C.hammenii Burger, Concavissimisporites sp. cf. C.variverrucosus (Couper) Brenner, C. sp., Cyathidites australis, C.minor, Dictyophyllidites harrisii Couper, Eucommiidites minor Groot and Penny, Exesipollenites scabrosus Norris, Impardecispora apiverrucatus (Couper) Venkatachala et al., Inaperturopollenites limbatus Balme, Klukisporites pseudoreticulatus Couper, Leptolepidites verrucatus, L. sp., Lycopodiumsporites austroclavatidites, L. sp., Parvisaccites radiatus Couper, Parvisaccites sp., Perinopollenites elatoides, Podocarpidites sp. cf. P.ellipticus Cookson, Reticulatasporites sp.
Algae: Botryococcus sp..

Comments
The presence of I.apiverrucatus, C.abacus, P.radiatus and other taxa is consistent with a latest Jurassic-earliest Cretaceous age. The abundance of well-preserved miospores including many Classopollis spp. (numerous tetrads) and bisaccates together with splintery inertinitic phytoclasts, Botryococcus, and an absence of marine phytoplankton suggest that deposition took place in oxygenated non-marine, lagoonal conditions.

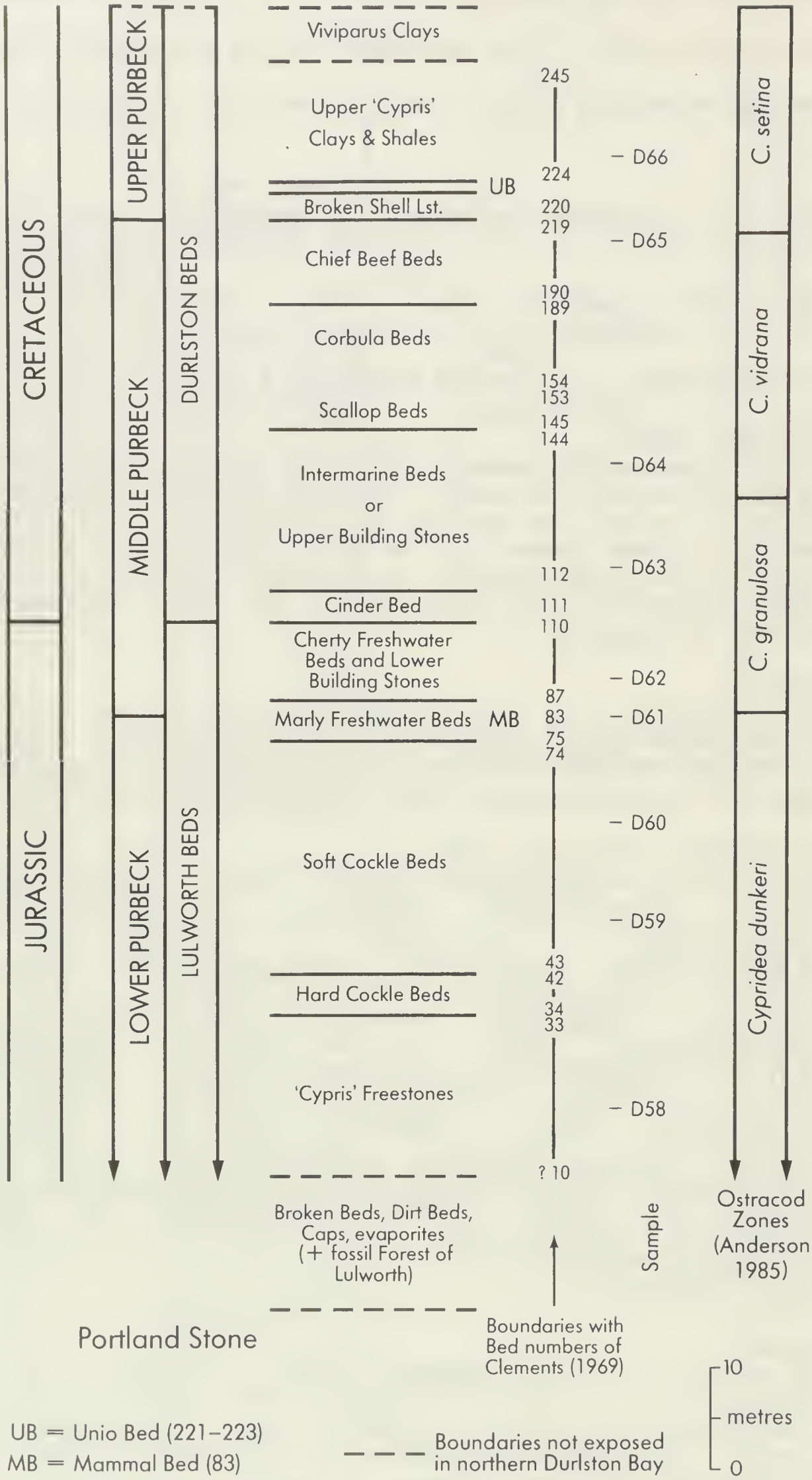


Fig. 13. Outline lithostratigraphy of the Purbeck Group and the Jurassic-Cretaceous boundary sequence in Durlston Bay. (After Clements 1969).

Isle of Purbeck, Durlston Bay (SZ 03507800-SZ04057862) (fig.13).

The rocks of the Purbeck Group are of marginal and non-marine origin with strong terrestrial influences. Evaporites and sabkha-type deposits occur with soils, algal and bioclastic limestones and clays. A great range of fossils occur including insects and vertebrates, but ostracods and molluscs are particularly common. The use of ostracods by Edward Forbes in 1851 to subdivide the Purbeck must be the first ostracod zonation, and possibly the oldest zonation scheme based upon microfossils. Although these deposits are well displayed in the Lulworth area the best exposure is at Durlston Bay, near Swanage, where they are 120m thick. The sequence is divided into Lulworth and Durlston Beds below and above a prominent (3m) oyster accumulation called the Cinder Bed. The Cinder Bed is one of several levels considered to reflect marine or quasi-marine influences, but it is such an important feature that by convention it is correlated with the Jurassic/Cretaceous boundary.

The best available section for Durlston Bay is that of Clements (in Cope et al. 1969, fig.A35). Samples were collected from the Zig-Zag Path to Peveril Point.

Sample D58 (Lulworth Beds, "Cypris" Freestones, circa Bed 15e Clements)

No calcareous microfossils recovered.

PALYNOMORPHS (DJB, JKL, AMM)
Miospores: Abietineaepollenites minimus Couper, A. spp., Alisporites bilateralis, Araucariacites australis, Callialasporites dampieri, C.turbatus, C. sp., Cerebropollenites mesozoicus, Classopollis hammenii, C.torosus (Reissinger) Balme, C. sp., Cyathidites australis, C.minor, Deltoidospora hallii Miner, Eucommiidites minor, Gleicheniidites circinidites (Cookson) Dettman), Januasporites tumulosus Norris, Klukisporites pseudoreticulatus, K. sp., Leptolepidites psarosus Norris, L. sp., Lycopodiumsporites austroclavatidites, Monosulcites sp., cf.Neoraistrickia sp., Peltandripites tener Norris, Perinopollenites elatoides, Pilosisporites delicatulus Norris, Podocarpidites sp. cf. P.ellipticus, P. sp., Staplinisporites caminus (Balme) Pocock, Todisporites minor, Verrucosisporites sp..
Algae: Botryococcus sp., Schizosporis parvus Cookson and Dettman,

S.spriggi Cookson and Dettman.

Comments
The occurrence of P.delicatulus, J.tumulosus and other species is consistent with a latest Jurassic-Early Cretaceous age determination. Environment as D57.

Sample D59 (Lulworth Beds, Soft Cockle Beds, top Bed 43 Clements)

No FORAMINIFERA or CALCAREOUS NANNOFOSSILS recovered.

OSTRACODA (RGC)
Scabriculocypris trapezoides Anderson.

Comments
S.trapezoides ranges through the Lower Purbeck and into the lower Middle Purbeck and typically occurs in moderate salinity lagoonal associations (typically "stage 2'" of the "Closed Series" of Clements 1973 MS.).

PALYNOMORPHS (DJB, JKL, AMM)
Miospores: Abietineaepollenites spp., Alisporites bilateralis, A. sp., Araucariacites australis, Baculatisporites comaumensis (Cookson) Potonie, Callialasporites dampieri, C.trilobatus, C.turbatus, C. sp., Cerebropollenites mesozoicus, Cicatricosisporites abacus Burger, C.angicanalis Doring, C.australiensis, C. sp. cf. C.hughesii Dettman, C.purbeckensis Norris, Classopollis echinatus Burger, C.hammenii, C. spp., Converrucosisporites saskatchewanensis Pocock, C. spp., Coptospora sp., Coronatispora valdensis (Couper) Dettman, ?Couperisporites complexus (Couper) Pocock, Cyathidites minor, Desoisporites microrugulatus Brenner, Dictyophyllidites harrisii, Eucommiidites minor, Foraminisporis wonthaggiensis (Cookson and Dettman) Dettman, Gleicheniidites senonicus, G.circinidites (Cookson) Dettman, Inaperturopollenites limbatus, I. sp., Januasporites spiniferus Singh, J.tumulosus, Klukisporites sp. cf. K.foveolatus Pocock, K.pseudoreticulatus, K. sp., Lycopodiumsporites austroclavatidites, cf.Neoraistrickia sp., Osmundacidites wellmanii, Peltandripites tener, Perinopollenites elatoides, Podocarpidites ellipticus, P. sp., Reticulatasporites sp., Staplinisporites caminus, Verrucosisporites sp..
Dinoflagellate cysts: Ctenidodinium sp. cf. C.culmulum (Norris) Lentin and Williams, C.schizoblatum (Norris) Lentin and Williams, Ellipsoidictyum reticulatum, Hystrichodinium voigtii (Alberti) Davey, ?Hystrichosphaerina sp..
Algae: Botryococcus sp..

Comments
The association of C.purbeckensis, C.hughesii, C.angincanalis, E.reticulatum, C.schizoblatum, C. sp. cf. C.culmulum and H.voigtii suggests an early Berriasian age. Organic composition is similar to D57 and D58 apart from the occurrence of rare dinocysts. Classopollis spp. (frequently in masses and tetrads) dominate the preparation. Deposition in a brackish lagoon is suggested.

Sample D60 (Lulworth Beds, Soft Cockle Beds, low Bed 60 Clements)

No FORAMINIFERA or CALCAREOUS NANNOFOSSILS recovered.

OSTRACODA (RGC)
Very poorly preserved, most of the specimens are individually specifically and even generically indeterminate.
Mantelliana cf. purbeckensis, Scabriculocypris trapezoides, Cypridea sp. indet., one or two other ostracod spp. indet., one foram contaminant.

Comments
A typical Lower Purbeck (sensu anglica) assemblage (although all the forms are longer ranging), representing a moderate salinity lagoonal association ("stage 2'" of the "closed series" Clements 1973 MS.).

PALYNOMORPHS (DJB, JKL, AMM)
Miospores: Abietineaepollenites spp., Alisporites bilateralis, A. sp., Araucariacites australis, Callialasporites turbatus, Cerebropollenites mesozoicus, Cicatricosisporites sp. cf. C.australiensis, C. sp. cf. C.hughesii, Classopollis spp., Concavissimisporites variverrucatus (Couper) Brenner, C. sp., Converrucosisporites sp., Coptospora sp., Coronatispora valdensis, Cyathidites minor, Gleicheniidites circinidites, Inaperturopollenites limbatus, Januasporites tumulosus, Leptolepidites verrucatus, cf.Neoraistrickia sp., Perinopollenites elatoides, Podocarpidites sp., Staplinisporites caminus, Trilobosporites sp.. Verrucosisporites sp..
Algae: Botryococcus sp..

Comments
Miospores are common but generally poorly preserved. The assemblage is dominated by bisaccate pollen grains. The abundance of amorphous organic matter and the presence of Botryococcus indicate deposition in a restricted, non-marine lagoon.

Sample D61 (Lulworth Beds, Marly Freshwater Beds, Bed 83 Clements)

OSTRACODA (RGC)
Scabriculocypris trapezoides, gastropod (fragmentary, internal moulds) indet.

No FORAMINIFERA, CALCAREOUS NANNOFOSSILS or PALYNOMORPHS (only black phytoclasts and degraded plant fragments) recovered.

SAMPLE D62 (Lulworth Beds, Cherty Freshwater Beds, Bed 93 Clements)

OSTRACODA (RGC)
Cypridea dunkeri Jones, C.posticalis Jones, C. sp. juv.(?) indet., Darwinula leguminella (Forbes), D.oblonga (Roemer), Mantelliana (?) sp. indet. (contaminant?).

Comments
C.posticalis is a highly characteristic species with restricted vertical range and a wide geographic distribution. It is associated with the transition from C.granulosa s.s. to C.granulosa fasciculata Zones and with the beds immediately below where the Jurassic/Cretaceous boundary is currently conventionally drawn in southern England and north-west Germany. C.dunkeri is a Lower Purbeck and lower Middle Purbeck (sensu anglica) species. The assemblage indicates a low salinity/freshwater environment.

The presence of Mantelliana suggests the association may belong to Clements' (1973 MS) "closed series" rather than his "open series".

No FORAMINIFERA or CALCAREOUS NANNOFOSSILS recovered.

PALYNOMORPHS (DJB, JKL, AMM)
Miospores: Abietineaepollenites sp., Alisporites sp., Araucariacites australis, Callialasporites turbatus, Cerebropollenites mesozoicus, Cicatricosisporites sp., Classopollis echinatus, C. sp., Concavissimisporites variverrucatus, Converrucosisporites sp., Deltoidospora sp., Ischyosporites crateris Balme, Klukisporites sp., Perinopollenites elatoides, Podocarpidites cf. P.ellipticus, P. sp., Vitreosporites pallidus.
Algae: Botryococcus sp., Schizosporis sp..

Comments
Small miospore assemblage dominated by P.elatoides. Most specimens poorly preserved, some severly degraded by bacterial action. The large number of Botryococcus colonies in association with amorphous organic matter suggest that deposition occurrred in a non-marine (fresh to ?brackish) environment.

(Cinder Bed = Bed 111 Clements: correlated to Jurassic/Cretaceous boundary).

Sample D63 (Durlston Beds, Intermarine Beds, Bed 115 Clements)

OSTRACODA (RGC)
Bisulcocypris striata Martin, Cypridea cf. brevirostrata Martin, Cypridea granulosa fasciculata (Forbes), Darwinula leguminella.
+ Charophyte remains.

Comments
C. granulosa fasciculata and C. cf. brevirostrata indicate an upper Middle Purbeck (sensu anglica) age, near the top of the C.granulosa fasciculata Zone. In England B.striata is most typical of the Upper and Middle Purbeck Beds. The assemblage suggests low salinity/freshwater, open lagoon/estuarine conditions ("stage 1" of the "open series" of Clements 1973 MS).

No FORAMINIFERA or CALCAREOUS NANNOFOSSILS recovered.

PALYNOMORPHS (DJB, JKL, AMM)
Miospores: Abietineaepollenites sp., Cerebropollenites mesozoicus, Classopollis sp., Deltoidospora sp., Parvisaccites sp..
Algae: Botryococcus sp..

Comments
Presence of Botryococcus suggests a non-marine environment.

Sample D64 (Durlston Beds, Intermarine Beds, Bed 138 Clements)

OSTRACODA (RGC)
Cypridea cf. vidrana Wolburg, Macrodentina (Dictyocythere)

mediostricta (Sylvester-Bradley), Orthonotacythere nodosaria Anderson, ostracods indet..

Comments
C.vidrana is typical of, and typically confined to, the eponymous uppermost zone of the Middle Purbeck (sensu anglica). M.(D.)mediostricta and O.nodosaria are strongly euryhaline elements and the assemblage indicates moderate (?mesohaline) salinities in an open lagoon/estuarine setting (upper part of "stage 2" of the "open series" of Clements 1973 MS).

No FORAMINIFERA or CALCAREOUS NANNOFOSSILS recovered.

PALYNOMORPHS (DJB, JKL, AMM)
Miospores: Abietineaepollenites spp., Araucariacites australis, Callialasporites trilobatus, Cerebropollenites mesozoicus, Classopollis sp., Converrucosisporites sp., Cyathidites australis, Deltoidospora hallii Miner, D. sp., Leptolepidites sp., Parvisaccites radiatus Couper, P. sp., Perinopollenites elatoides, Podocarpidites ellipticus, Staplinisporites caminus.
Dinoflagellate cysts: Canningia sp. cf. C.compta Davey, Cyclonephelium brevispinatum (Milliou) Below, C.hystrix, Dissiliodinium sp., Escharisphaeridia pocockii (Sarjeant) Erkmen and Sarjeant, Hystichogonyaulax sp. cf. H.cladophora (Deflandre) Stover and Evitt, H. sp. cf. H.pennata (Riley) Lentin and Williams, Lithodinia sp., Mendocodinium groenlandicum, Microdinium sp., Muderongia simplex microperforata Davey.
Algae: Botryococcus sp..

Comments
The presence of a dinocyst assemblage of limited diversity, together with black phytoclasts and other oxidised plant tissue suggest that depostion occurred in near-shore marine/lagoonal conditions.

Sample D65 (Durlston Beds, Chief "Beef" Beds, Bed 213 Clements)

OSTRACODA (RGC)
Bisulcocypris sp. juv. cf. striata, Cypridea cf. penshurstensis Anderson, Darwinula cf. oblonga, D. cf. D.leguminella, ?Rhinocypris jurassica? (Martin).

Comments
A low salinity/freshwater assemblage (probably "stage 1" of Clements' 1973 MS "open series"). All are long-ranging forms. C. cf. penshurstensis is consistent with a C.vidruna Zone age but ranges through the whole of the upper Middle and Upper Purbeck Beds.

No FORAMINIFERA or CALCAREOUS NANNOFOSSILS recovered.

PALYNOMORPHS (DJB, JKL, AMM)
Miospores: Abietineaepollenites sp., Alisporites bilateralis, A. sp., Araucariacites australis, Callialasporites dampieri, C. sp., Cerebropollenites mesozoicus, Cicatricosisporites abacus, C. sp., Classopollis hammenii, C. spp., Converrucosisporites spp., Cyathidites australis, C.minor, Desoisporites microrugulatus, Eucommiidites minor, Granulatisporites sp., Parvisaccites sp., Perinopollenites elatoides, Podocarpidites ellipticus,

Staplinisporites caminus, Trilobosporites domitus Norris, T.obsitus Norris.
Algae: Botryococcus sp..

Comments
The presence of T.obsitus, T.domitus and C.abacus is consistent with an age determination of earliest Cretaceous (Berriasian). An abundance of organic matter and the presence of Botryococcous is indicative of restricted, non-marine lagoonal conditions.

Sample D66 (Durlston Beds, Upper "Cypris" Clays and Shales, 0.5m below top Bed 233 Clements)

OSTRACODA (RGC)
Cypridea propunctata Sylvester-Bradley (includes some early instars of this (?) sp.), C.setina (Anderson), Rhinocypris jurassica (Martin).

Comments
Both C.setina and C.propunctata are typical and characteristic of the C.setina Zone (= Upper Purbeck sensu anglica as normally defined). Both species range somewhat beyond the limits of the zone. A low salinity/ freshwater assemblage ("stage 1" of Clements 1973 MS. "open series"). In the Upper Purbeck this is probably the closest approach in the whole formation to true freshwater assemblages.

No FORAMINIFERA or CALCAREOUS NANNOFOSSILS recovered.

PALYNOMORPHS (DJB, JKL, AMM)
Miospores: Abietineaepollenites sp., Alisporites bilateralis, A. sp., Araucariacites australis, Callialasporites dampieri, C.obrutus Norris, C.trilobatus, C. spp., Cerebropollenites mesozoicus, Cicatricosisporites abacus, C.australiensis, C.purbeckensis, C. sp., Classopollis hammenii, C. sp., Concavissimisporites variverrucatus, cf.Converrucosisporites sp., Cyathidites australis, C.minor, Cycadopites sp., Eucommiidites minor, Gleicheniidites senonicus, Inaperturopollenites sp., Ischyosporites crateris Balme, Osmundacidites wellmanii, O. sp. cf. O.wellmanii, Parvisaccites radiatus, P. sp., Perinopollenites elatoides, Podocarpidites ellipticus, P. sp., Polycingulatisporites sp., Staplinisporites caminus, Todisporites minor, Trilobosporites obsitus, Verrucosisporites sp..
Dinoflagellate cysts: Escharisphaeridia pocockii.
Other algae: Botryococcus sp., Schizosporis parvus Cookson and Dettman.

Comments
The association of P.radiatus, C.purbeckensis, T.obsitus, C.crassiexinus and C.obrutus suggests a Berriasian-Valanginian age. The rather poorly preserved miospore assemblage is dominated by bisaccates but P.elatoides is also abundant. The presence of Botryococcus and S.parvus and the morphological diversity of the miospores suggest a strong freshwater influence on the environment of deposition.

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J.E. Robinson

The Portland Raised Beach

The Portland Raised Beach is one of the classic sites of British Geology. Described as a deposit of "marine shingle" by Henry De la Beche as early as 1839, the pebble gravel rests upon a wave-cut limestone platform some eight to ten metres above present sea-level. De la Beche compared it with a similar deposit seen on the headland of Hope's Nose near Torquay in South Devon 60 km west of Portland, and took both as evidence of higher sea-level in former times (De la Beche 1839). Later accounts (Whitaker 1869, Baden-Powell 1930, Arkell 1947, Keen 1985) have debated the age of the beach (which inter-glacial does it represent?), its implications for

climate (colder than present day?), or its faunal implications.

In fact, in the most recent accounts (Davies and Keen 1985, Keen 1987), it is recognised that there are two beaches: and older Western Beach seen just to the west of the lighthouse, and a younger Eastern Beach, much more extensive, seen on the cliff top east and north of the lighthouse. In addition, there are younger, overlying deposits to both beaches which are contorted "head", a solifluction soil which has yielded a freshwater fauna of molluscs and ostracods, demonstrating the interglacial character of both deposits.

The beaches are composed of subangular clasts of Purbeck and Portland limestones, derived from the very local outcrops, with only rare pebbles of flint and chert from the Cretaceous inland. The interstitial sands include pockets of concentrated shells, mainly molluscs of an intertidal character. The shelliest beach is to be found closest to the lighthouse. From this area, 2kg of sand yielded 6670 molluscs, chiefly Littornia spp., Gibbula spp., Patella sp. and Rissoa sp., together with plates of Balanus (Keen, 1987).

No ostracods have been recorded from the beach, but a fauna of inshore foraminifera have been listed by Professor J.R.Haynes and Dr. A.R.Lord (in Davies and Keen 1985): Elphidium crispum (L.), Millolina seminulum (L.), Quinqueloculina seminulum (L.), Quinqueloculina intricata (L.), Massalina secans (d'Orbigny), Miliolina subrotunda (Montagu), Polystomella striatopunctuata (F.& M.), "Rosalina" parisiensis.

On the basis of what were considered to be "northern" molluscs, it was

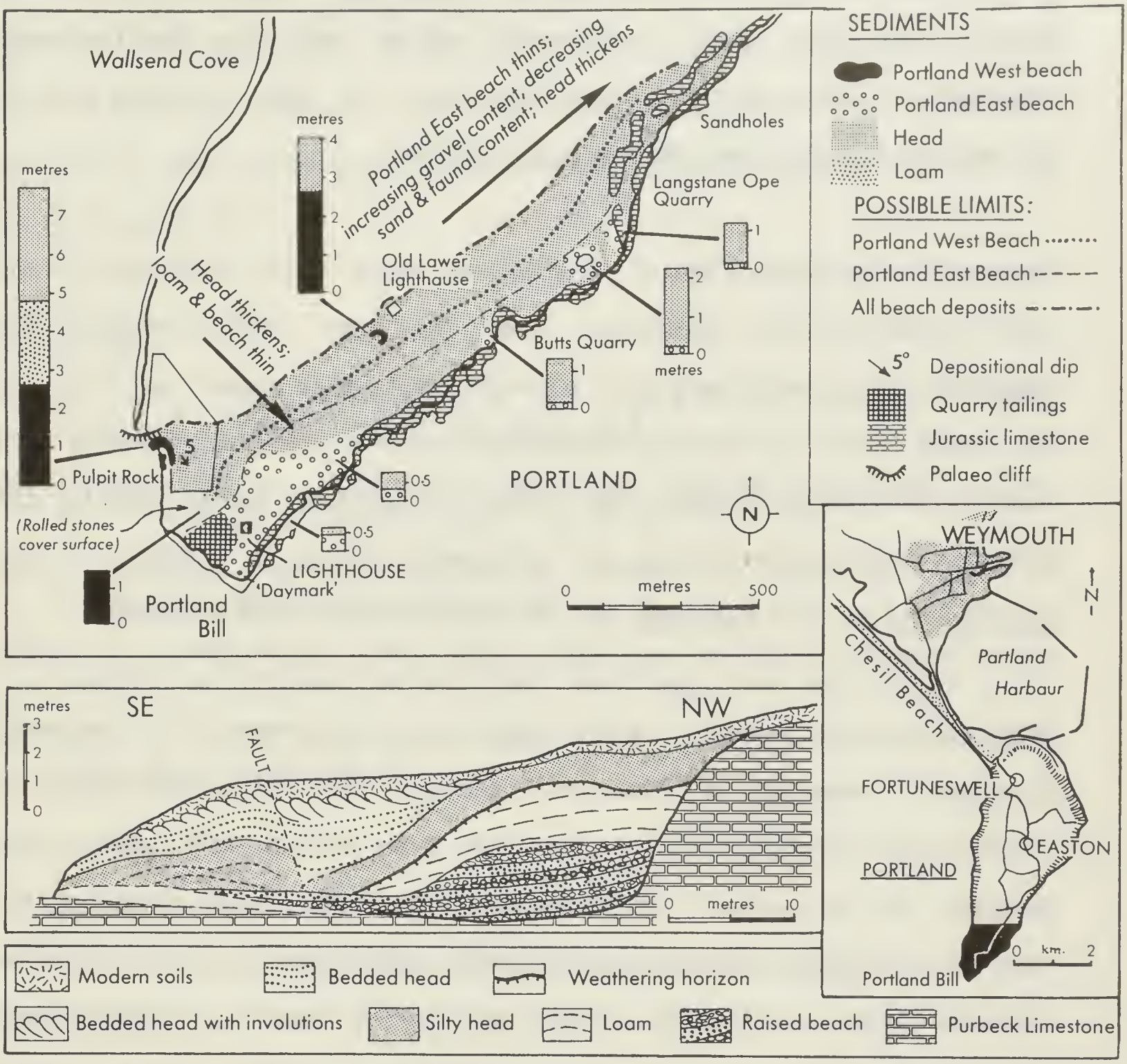

Fig. 14. Quaternary deposits of the southern Isle of Portland. (Redrawn after Davies and Keen 1985).

concluded that the sea-water tempperatures of the beach could have been as much as 4 F (2.2 C) cooler than present (Baden-Powell 1930). More recent analysis of those shells and others which may have Mediterranean occurrence, suggest that on balance, the fauna is very close to that of the English Channel today (Davies and Keen 1985).

Compared to the Eastern Beach, the Western Beach on the cliff tops to the north and west of the lighthouse, shows the same pebble content of the limestone clasts, but there are rare rock types which suggest an origin in the south west of England. The pebbles, however are lime cemented and coated with distinct crusts. The fauna is decidedly poorer than for the Eastern Beach, consisiting of infrequent shells of Mytilus sp., Cerastoderma sp. and Buccinum sp.. No microfauna has been recorded.

Both beaches are capped by a fine loam of orange-brown silty sand with occasional fragments of limestone. On the east cliffs the deposit is largely decalcified, but this is less the case moving west where good sections are preserved, unfortunately within the closed compund of the Admiralty Underwater Weapons Establishment. These deposits have yielded an ostracod fauna consisiting of the calc-spring species, Psychrodromus olivaceus and the pond species, Ilyocypris gibba. These signify temperate freshwater conditions, later disturbed by frozen ground conditions which produced visible contortionsto bedding.

Reviewing the whole fauna, macro- and micro-, all species are extant; none are extinct or indicative of an older Interglacial age. Nevertheless, both beaches are perched some eight to ten metres above present sea-level, and sealed by evidence of cold, tundra conditions representing at least the last glacial period. Clarifying the situation, amino acid studies of beach

shells have given an amino group age 4 for the Western Beach, and age 3 for the Eastern Beach (Keen 1987). By reference to amino acid results for the cave of Belle Hougue, Jersey, which are dated as Ipswichian, 121,000 +/- 14, 000 BP, Oceanic stage 5e, the results for East Beach are comparable. West Beach may be older and equivalent to Oceanic stage 7, 200 000 +/- 30,000 BP.

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RECENT

Living Ostracoda and Foraminifera of The Fleet

J.E.Whittaker

OSTRACODA

(Extract from Porcupine Newsletter, 3(6), pp.135-139, 1986)

A survey of living ostracods was carried out on a seasonal basis between 1967 and 1969 (Whittaker 1972, 1981a), before The Fleet was invaded by Sargassum. Three assemblages of ostracods were recognised, corresponding almost exactly to the divisions of The Fleet suggested on the basis of the salinity regime (Whittaker 1980, 1981b). Unlike a normal estuary, The Fleet is long and narrow, with a relatively small input from rivers, a

large volume of "estuarine water" at low tide, and a tidal flow greatly retarded by the small size of the marine inlet. Thus a salinity gradient is well developed from Smallmouth to Abbotsbury, though the degree of dilution and hence steepness of the gradient varies seasonally. In terms of salinity, therefore, The Fleet can be divided into three parts:

1. A marine to near-marine part, extending from Smallmouth to Butterstreet Cove (the effective limit of the tidal flow), only extending further northwest during high tides in summer months and long periods of fine weather.

2. A high salinity brackish part, covering most of West Fleet, with salinity values between 15 and 30‰ in winter and spring, generally a little higher in the summer.

3. A low salinity brackish part found in Abbotsbury Embayment, with values frequently below 10‰ rising to 20‰ or more in periods of low stream discharge.

The chief factor influencing the salinity of The Fleet, as with water levels, is the tidal effect; this is despite the low tidal range (Robinson 1981) and the restricted marine inlet. This is then modified in the West Fleet by a small amount of percolation through the Chesil Bank and freshwater runoff.

Salinity is not the sole factor governing ostracod distribution, but it does appear to control the distribution of the algae and sea-grasses on which a great many invertebrates, including the ostracods, depend. The shallow waters of The Fleet behave like a gigantic rock pool, with, in spring and summer pH values (9), mean dissolved oxygen content (ca 150%) and mean water temperature (18°C) all very high compared to the open sea. It is also sheltered under most conditions by the Chesil Beach. The only

detrimental ecological parameter for sediment dwelling ostracods is the unsuitability of much of the substrate which, for most of The Fleet above the Narrows is composed of soft, toxic, organic silt. Only on the landward shore and in the vicinity of Abbotsbury Swannery and Smallmouth, are there tracts of suitable, well-oxygenated substrate which can support a benthic ostracod population. Many of these ostracods appear to be tolerant of a wide range of salinities and are governed more by the substrate type (e.g. Leptocythere lacertosa (Hirschmann)), but others are (e.g. L.porcellenea (Brady)) are still restricted to lower salinities.

Assemblage 1 - The East Fleet "Restricted Marine" Fauna

This assemblage is characterised by large numbers of marine phytal species which die out slowly westwards with distance from the sea, lowering salinity and disappearance of most marine seaweeds. No difference in fauna was found between the deeper water channels of Littlesea and the Narrows, characterised by luxuriant algae, and the shallow areas of Littlesea, characterised by Zostera and Ruppia, although ostracod populations in in the former tend to be more plentiful. This assemblage is termed "resricted marine" because there is a lower species diversity in comparison to Weymouth Bay. Nevertheless, the number of individuals in this sheltered environment is very large indeed. In total 20 phytal species were found living on the fronds of the algae and sea-grasses and associated epiphytes. Some of the more important ones include Paradoxostoma spp., (e.g. P.fleetense Horne and Whittaker, Xestoleberis rubens Whittaker and Hirschmannia viridis (Muller)). The commonest species of this assemblage is X.rubens, first described by Whittaker in 1978, and a remarkable local phenomenon; it has yet to be found elsewhere in Britain, although it has recently been found in W. and N.W. France. It is totally replaced in Weymouth Bay by another

xestoleberid, X.aurantia (Baird). The characteristic ostracod of the lower salinity assemblage 2, X.nitida (Lilljeborg), is found only on the Zostera/Ruppia beds in Littlesea, coexisting with X.rubens but gradually replacing it northwestwards. In addition 12 benthic species live either in the non-toxic sediment along the landward shore, in the sediment trapped by algal holdfasts, or in the extensive rootmass of Zostera.

Assemblage 2 - The West Fleet Fauna

This assemblage, found in the area from beyond Butterstreet Cove to Shipmoor Point, is characterised by a smaller number of species, both phytal and benthic, and by few individuals except in summer months. It is the realm of Zostera and Ruppia with their associate mat of "flannel weed" (trailing masses of filamentous, mainly green algae (Burrows, 1981)). When these sea-grasses die back in late autumn, very little microfauna can survive except in a few areas of stable, oxegenated sediment and green algae, mainly on the landward side. In winter the main population of Xestoleberis nitida appears to migrate into Littlesea. Only 2 indigeneous phytal species live in West Fleet; however, in summer months when salinities are higher, a further 4 phytal species migrate into West Fleet, though never in large numbers. A further 5 benthic species make up assemblage 2.

Assemblage 3 - The Abbotsbury Brackish Fauna

The Abbotsbury Embayment and adjacent Fleet has the lowest salinities of the lagoon, large expanses of well-oxygenated mud, Phragmites reedbeds and perennial freshwater dilution. It is the most typically estuarine of the Fleet environments. It is therefore not surprising that the ostracod fauna is marked by the appearance, for the first time in large numbers, of the truly brackish estuarine species Cyprideis torosa (Jones) and

Leptocythere porcellanea (Brady); in all 7 species are found alive.

In such an environment, the puzzling absence of Loxoconcha elliptica Brady, virtually ubiquitous throughout European estuaries (Whittaker, 1981c) is hard to explain. This is particularly so since thousands of its calcareous shells and disarticulated valves have been found in the sediment of the Abbotsbury Embayment and the shore stations of West Fleet. Live specimens have not been found despite a close search for its possible habitat. A clue to its disappearance may lie in a similar more widespread presence of dead shells of C.torosa in comparison to its live distribution. Perhaps at some time in the past The Fleet (at least in West Fleet), presented a much more brackish environment than today. Whether this can be placed as recently as before the building of Portland Harbour and the first Smallmouth bridge (pre-1840/1850) when the tidal inlet there may have been more susceptible to silting, is debatable. Under such conditions, The Fleet could have been cut off for long periods from the sea, becoming brackish and even hypersaline.

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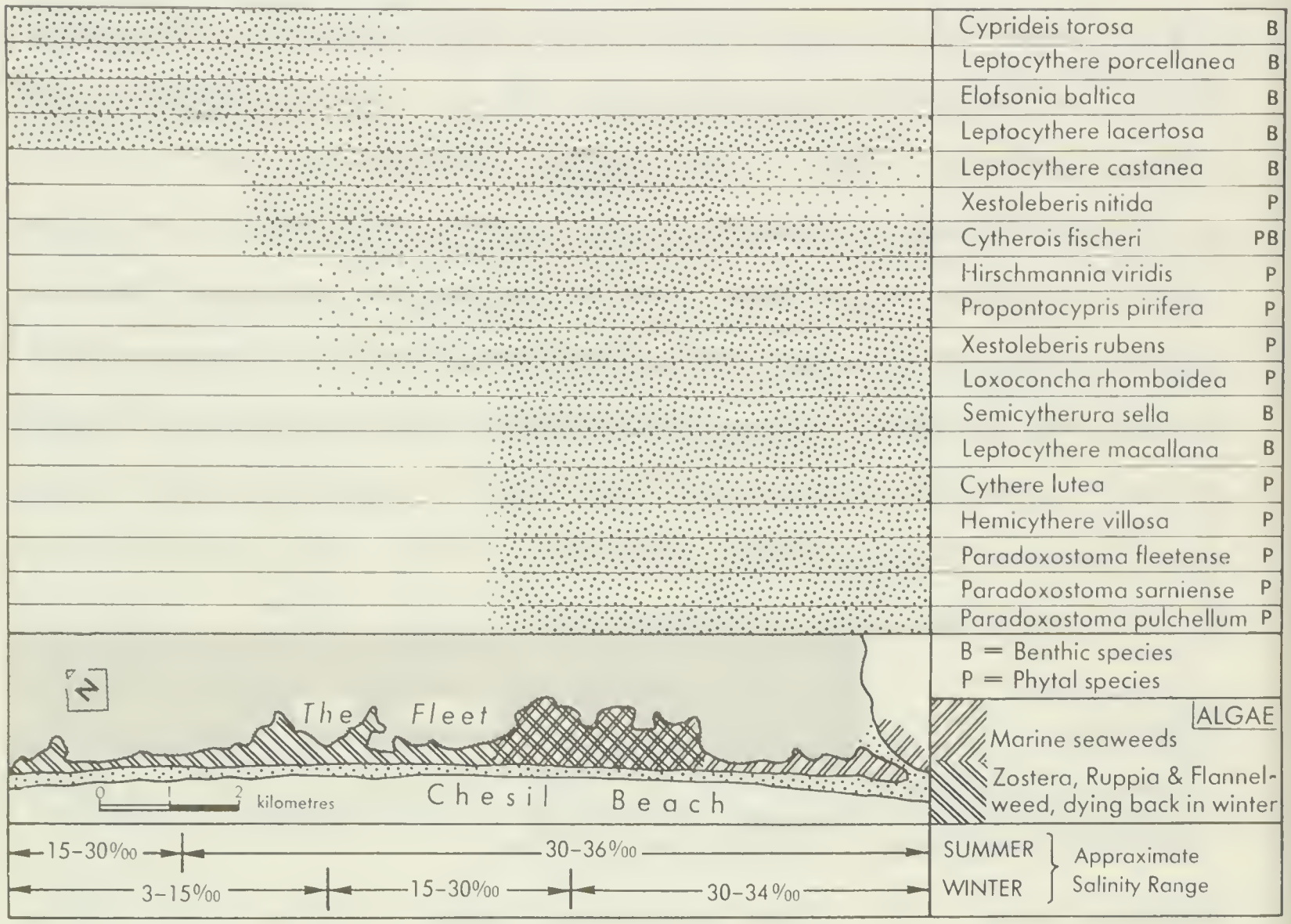


Fig. 15. Distribution of Recent ostracods in The Fleet. (Redrawn after Whittaker 1986).

FORAMINIFERA

The foraminifera of The Fleet have received litle attention and the information below is based upon two unpublished dissertations by J.M.Stephens (M.Sc. Wales, 1969) and E.C.Humphrey (M.Sc. Southampton, 1981).

Assemblage 1 - The East Fleet Fauna

A restricted marine fauna of mainly phytal species has been recognised. Ammonia batavus (Hofker) s.s., Elphidium macellum (Fichtel and Moll), E.margaritaceum (Cushman), E.williamsoni Haynes and miliolids being particularly common. On the mudflats of Littlesea (with Zostera and green-algae), in shallow water, very large numbers of Eggerelloides scaber (Williamson) and Quinqueloculina aspera d'Orbigny are also found.

Assemblage 2 - The West Fleet Fauna

West of Butterstreet Cove to Shipmoor Point there is a marked decrease in marine species and an increase in species that can tolerate wider extremes of salinity, etc.. Common species include: Ammonia batavus (Hofker) s.l. (the tepida and limnetes forms), Elphidium williamsoni Haynes, Haynesina germanica (Ehrenberg), Elphidium waddenense Voorthuysen, Quinqueloculina aspera d'Orbigny and Ammoscalaria runiana (Heron-Allen and Earland).

Assemblage 3 - The Abbotsbury Brackish Fauna

The true brackish fauna of Ammonia batavus (limnetes forms) and Haynesina germanica (on algae) and Jadammina macrescens (Brady) and Trochammina inflata (Montagu) (in well-oxygenated mud associated with the Phragmites reedbeds).

THE ISLE OF WIGHT

Introduction

The Isle of Wight is located (Figure 1) near the western end of the Hampshire-Dieppe Basin. Below a thin development of Pleistocene gravels, clays and sands there is exposed a succession of sedimentary rocks ranging in age from Early Cretaceous to Early Oligocene. The oldest rocks are exposed in the cores of two asymmetrical anticlines, the Brixton (or Brighstone) Anticline in the west and the Sandown Anticline in the east. In both folds the northern limb is the steeper, both of which combine to produce a major ridge of nearly vertically dipping chalk which strikes across the centre of the island from west to east (Figure 3). To the north of this major structure there are a series of minor folds all of which trend WNW-ESE. The tectonic activity was probably concentrated in the Late Oligocene-Early Miocene although early phases of activity can be detected from the Early Palaeocene onwards.

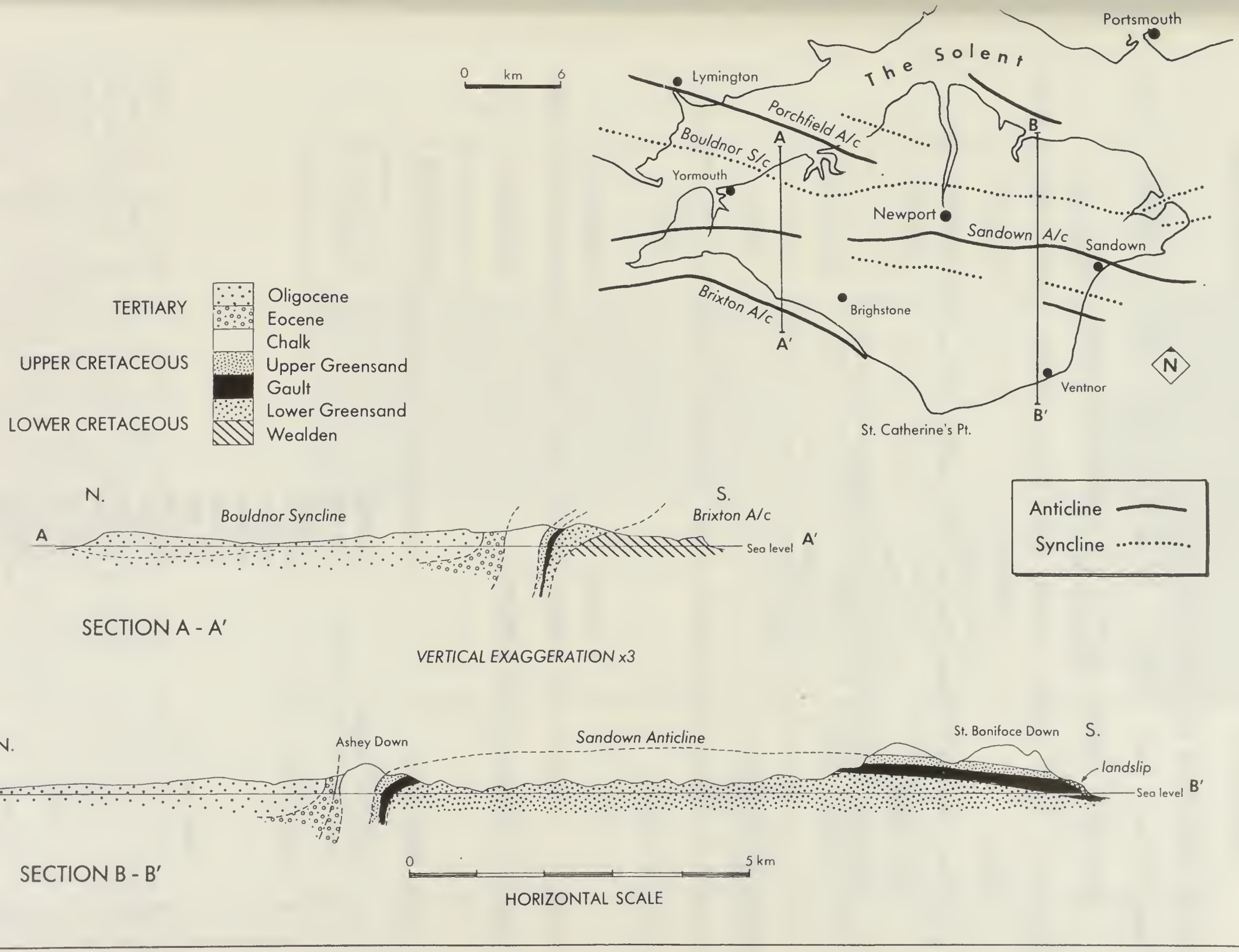
CRETACEOUS

M. B. Hart, P. P. E. Weaver, R. G. Clements, J. A. Burnett, B. A. Tocher, D. J. Batten, J. K. Lister and A. M. MacLennan.

The stratigraphic nomenclature of the UK Cretaceous was stabilised by the publication of Rawson et al. (1978). Since that time there have been proposals that affect the lithostratigraphy of the chalk (Mortimore 1986, Robinson 1986) and the lithostratigraphy of the Aptian sediments (Simpson 1985). Recent accounts of Cretaceous geochronology (Harland et al. 1982, Hallam et al. 1985) have given very little information on the

Tertiary
Chalk
Gault - U. Greensand
Lower Greensand
Wealden
Upper Jurassic
Middle Jurassic
Lower Jurassic

Trowbridge Inlier
Vale of Pewsey
Shalbourne Inlier
Newbury
LONDON BASIN
SALISBURY PLAIN
Peasmarsh or Hog's Back Anticline
Stockbridge Anticline
Winchester Anticline
Vale of Wardour
Salisbury
DEAN HILL
Bower Chalke Inlier
Portsdown Anticline
SOUTH DOWNS
Southampton
PORTS_DOWN
DORSET DOWNS
HAMPSHIRE BASIN SYNCLINE
DORSET
Lyme Regis
Selsey Bill
Poxwell A/cline
Weymouth Anticline
Weymouth
Purbeck Anticline
Brixton Anticline
Sandown A/cline.
ISLE OF WIGHT
Portland Bill
N
0 km 20


0 km 6
Portsmouth
The Solent
Lymington
Porchfield A/c
Bouldnor S/c
A
B
Yormouth
Newport
Sandown A/c
Sandown
Brixton A/c
A'
Brighstone
N
Ventnor
B'
St. Catherine's Pt.
TERTIARY
Oligocene
Eocene
Chalk
UPPER CRETACEOUS
Upper Greensand
Gault
LOWER CRETACEOUS
Lower Greensand
Wealden
N.
Bouldnor Syncline
S.
Brixton A/c
A
Sea level
A'
Anticline
Syncline
SECTION A - A'
VERTICAL EXAGGERATION x3
N.
Ashey Down
Sandown Anticline
St. Boniface Down
S.
landslip
B
Sea level
B'
SECTION B - B'
0
5 km
HORIZONTAL SCALE

microbiostratigraphy of the succession. The current nomenclature is summarised in Figure 1.

Source references for microfossils

Foraminifera: Barr (1962), Carter and Hart (1977), Bailey (1978), Swiecicki (1980), Hart *et al*. (1981), Crittenden (1983).

Ostracoda: Jones (1849), Jones and Hinde (1890), Neale (1978), Weaver (1982).

Calcareous nannoplankton; Black (1972, 1973, 1975), Crux (1980), Crux *in* Lord (1982).

Microplankton: Clarke and Verdier (1967).

Reference samples

A suite of samples collected by M. B. Hart was studied by all contributors (see Table 1).

Table 1. Details of sample locality data used in this Guide and sample number of the reference samples.

Sample	locality	Cretaceous Sample Number
I 1	Chilton Chine	CH/MBH 1
I 2	Compton Grange Chine	CH/MBH 1
I 3		CH/MBH 2
I 4	Atherfield Point	AP/MBH 1
I 5		AP/MBH 3
I 6		AP/MBH 2
I 7		AP/MBH 4
I 8	Compton Bay	CB/MBH 10
I 9		CB/MBH 8
I 10		CB/MBH 9
I 11		CB/MBH 2
I 12		CB/MBH 1
I 13		CB/MBH 4
I 14		CB/MBH 3
I 15		CB/MBH 6
I 16		CB/MBH 5
I 17		CB/MBH 7
I 18	Culver Cliff	CC/MBH 8

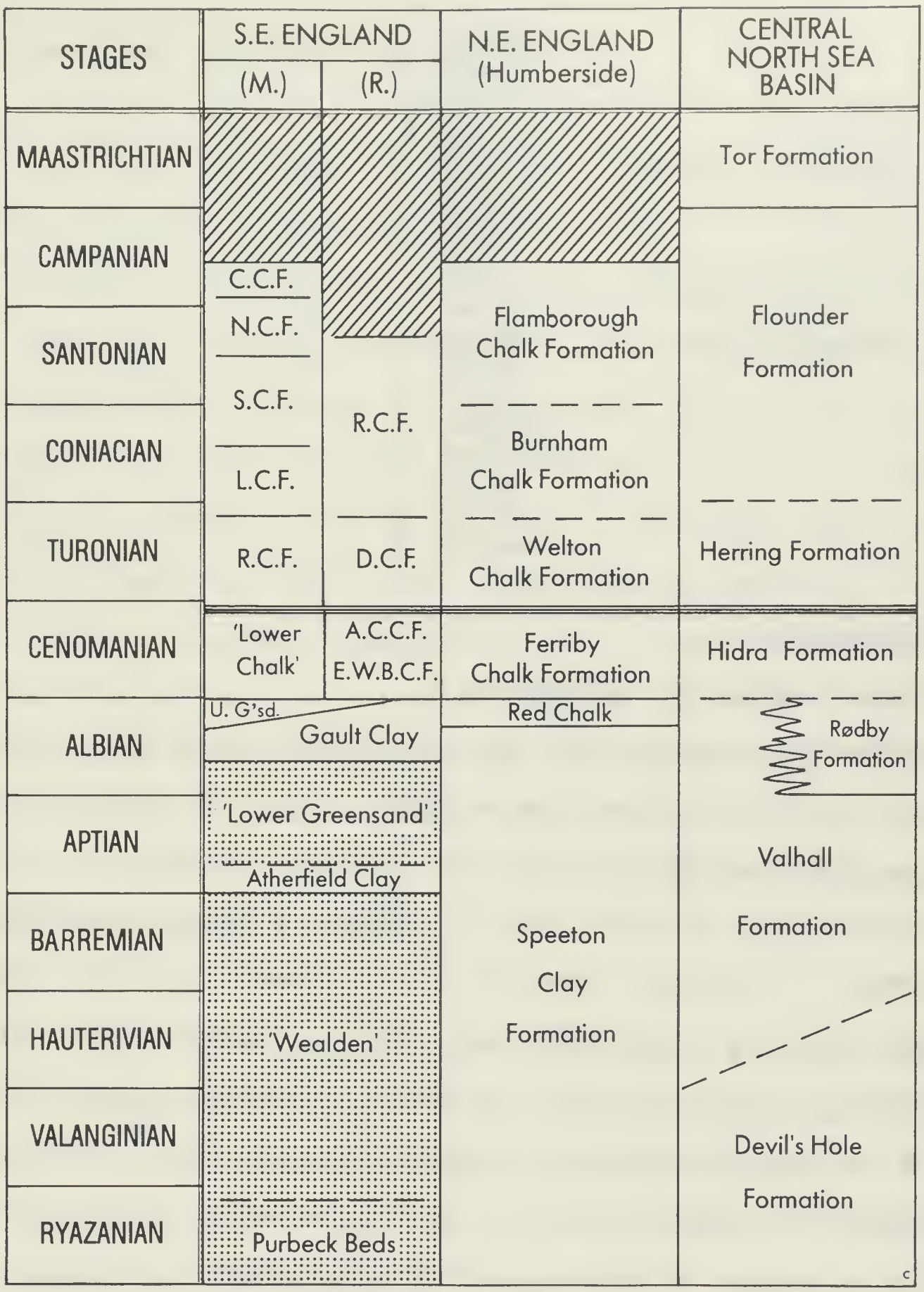


Figure 1. Outline lithostratigraphy of the United Kingdom. In SE England there have been two recent attempts at providing a lithostratigraphy of the chalk group (M - Mortimore, 1986; R - Robinson, 1986) and as there has been no time to assess their relative merits both are included in this figure. The abbreviations are; (M):CCF - Culver Chalk Formation, NCF - Newhaven Chalk Formation, SCF - Seaford Chalk Formation, LCF - Lewes Chalk Formation, RCF - Ranscombe Chalk Formation, (R):RCF - Ramsgate Chalk Formation, DCF - Dover Chalk Formation, ACCF - Abbots Cliff Chalk Formation, EWBCF - East Wear Bay Chalk Formation. The double line that runs across all the columns in the latest Cenomanian is the A.plenus Marls/Black Bank. In the Isle of Wight the Upper Greensand (UG) appears as a facies in the latest Albian.

I 19		CC/MBH 1
I 20		CC/MBH 7
I 21		CC/MBH 11
I 22		CC/MBH 9
I 23		CC/MBH 10
I 24		CC/MBH 3
I 25		CC/MBH 5
I 26		CC/MBH 6
I 27		CC/MBH 4
I 28		CC/MBH 2
I 29	Whitecliff Bay	WB/MBH 4
I 30		WB/MBH 3
I 31		WB/MBH 2
I 32		WB/MBH 7
I 33		WB/MBH 8
I 34		WB/MBH 1
I 35		WB/MBH 6
I 36		WB/MBH 5

General Comments

Calcareous Nannofossils (J.A.Burnett).

The dominantly non-open marine and non-calcareous nature of the sediments sampled at Chilton Chine, Compton Gorge Chine and Atherfield Point excludes the presence/preservation of calcareous nannofossils, although one particularly resistant species (Waznaueria barnesae) was identified in CH/MBH 1. Calcareous nannofossils are, however, abundantly preserved in the remaining chalk, marl and calcareous mudstone and siltstone lithologies although not in the glauconitic sandstone (CB/MBH 10). It should be noted that although the Upper Cretaceous chalk is essentially composed of calcareous nannofossils their preservation is frequently poor. This is a common phenomenon in chalks where there is little or no clay material to inhibit pore fluid movement.

Relatively little published information is available for British Late Cretaceous calcareous nannofloras. Crux (1980) analysed the biostratigraphy and taxonomy of the calcareous nannofossils and his zonation (published in Lord 1982) was used here. The writer's work is concerned with lineage studies, in part as an approach to refining

zonation based upon calcareous nannofossils.

Late Jurassic and Cretaceous (Portlandian - Turonian) palynomorphs (D.J.Batten, J.K.Lister and A.M.MacLennan).

The palynofacies associated with the samples selected from the Dorset Purbeck Beds are reasonably representative of this stratigraphic group. Most are dominated by miospores of gymnospermous origin (particularly Classopollis spp. and bisaccate pollen) and inertinitic debris. Botryoccocus is present in all but the single barren sample (D61) and is particularly numerous in D62, which also contains amorphous organic matter. Similar bacterially degraded detritus is especially abundant in D60 and D65 and for all three samples can be interpreted to indicate sediment accumulation when levels of oxygen were lowered. Periodic marine influence on the environment of deposition is inferred from the presence of a few dinoflagellate cysts in D59 and a more diverse assemblage of these microfossils in D64.

The organic content of the samples from the Barremian to Turonian sequence on the Isle of Wight can also be said to reflect with some accuracy the palynology on the entire succession. Only one sample (CH/MBH 1) from the Wessex Formation proved to be devoid of palynomorphs. The other two Wessex samples and the two from the younger Vectis Formation yielded characteristically varied assemblages that indicate deposition in fresh to slightly saline, and for AP/MBH 3 also temporarily reducing, conditions. Land plants are well represented by abundant miospores and/or vascular phytoclasts in both these and the Lower Greensand samples but the latter differ in also containing diverse assemblages of marine phytoplankton.

The preparations of the samples from the Gault Clay and younger

formations, by contrast, contain very few miospores; indeed one sample (CC/MBH 9) proved to be entirely devoid of them. Dinoflagellate cysts are the dominant component. The associated organic matter consists mainly of degraded vitrinitic and inertinitic detritus which, along with the poor preservation of some of the cysts, indicates deposition in oxidising conditions.

Chilton Chine - Compton Grange Chine - Atherfield Point.

The south-west facing coast of the Isle of Wight (Figure 2) displays a near-continuous succession of Lower Cretaceous strata (Wessex Formation, Vectis Formation and 'Lower Greensand') on each limb of the Brixton Anticline. Despite the short distances involved there are marked differences between the two successions; that on the northern limb being considerably thinner.

The Wessex Formation (formerly the Wealden Marls) is represented by a series of varicoloured mudstones, siltstones and sandstones (Daley and Stewart 1979, Stewart 1981 a, b). The latter usually consist of fining-upwards cycles, with large-scale cross-bedding, horizontal bedding and small scale cross-lamination. Many of the sandstones have conglomeratic bases and chanelling is seen in many places. There are accumulations of wood and vertebrate material at several horizons in the succession. The whole sequence of strata represents a broad floodplain that was crossed by meandering streams; the sandstones representing channel-fill deposits while the mudstones are the overbank sediments. The overlying Vectis Formation (formerly Wealden Shales) is a series of grey or grey-green mudstones with minor sandstones. There is one major sandstone unit (the Barnes High Sandstone Member) towards the base of the formation. Bioturbation is common and the succession shows increasing

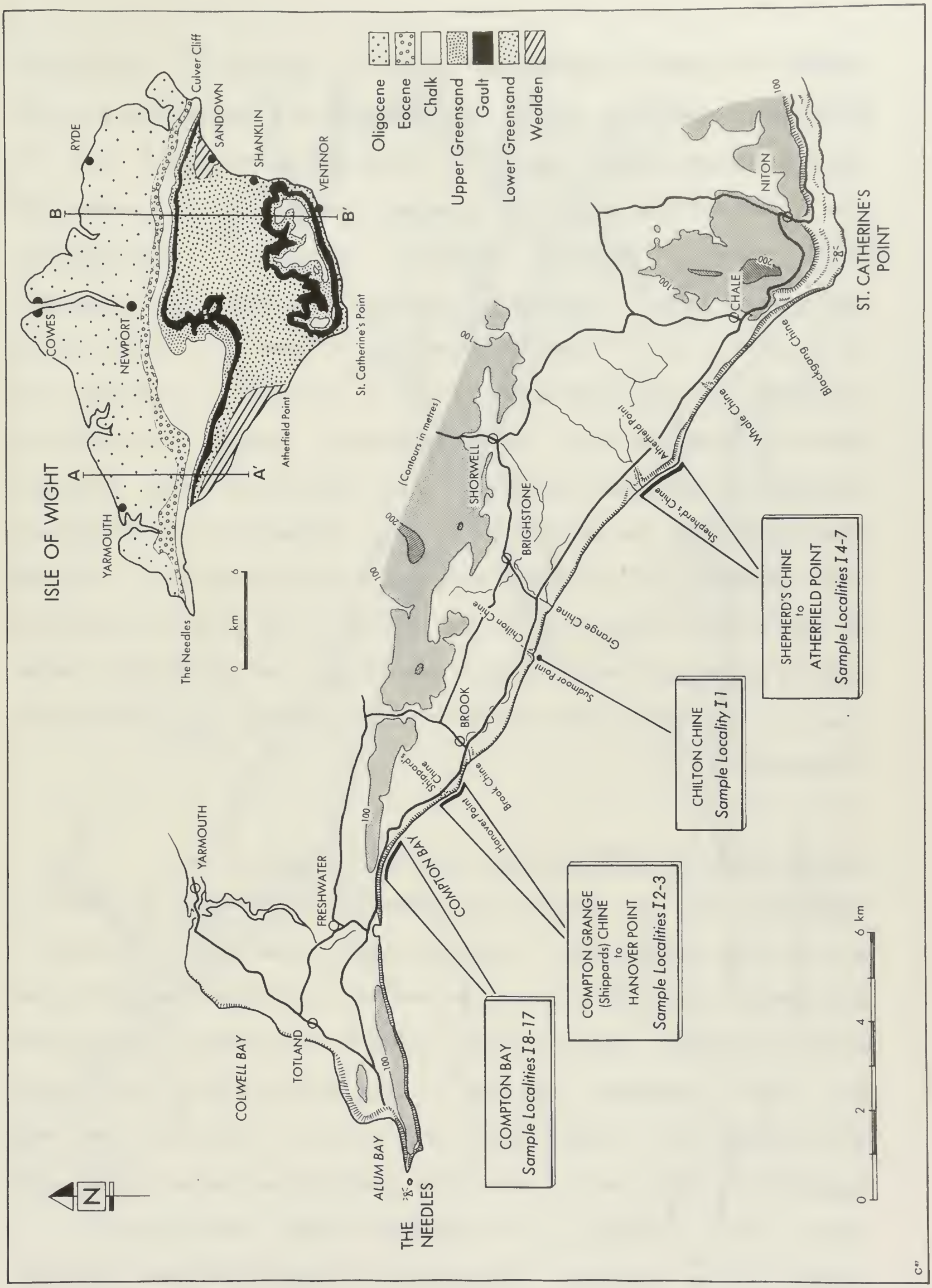


Figure 2. Locality map for Sample Localities 1-17 on the west coast of the Isle of Wight. Care must be taken as the cliffs are all potentially dangerous and tides are also a problem, especially in Compton Bay.

evidence of marine penetration into a fresh-water lake/lagoonal environment towards the top of the formation and the junction with the 'Lower Greensand' marks a change to a fully marine succession that is clearly demonstrated by a basal calcareous sandstone that is crowded with marine fossils (Mulletia mulleti, Gervillella sublanceolata, Holocystis elegans, Sellithyris sellis and Cymatoceras radiatum). The Atherfield Clay 'Formation' consists of brown-grey, silty clay and claystones but the succession is usually obscured by landslips and mudflows. From Atherfield Point southwards there is a continuous succession of the 'Lower Greensand' (Casey 1961, Dike 1972, Daley and Insole 1984) with the Atherfield Clay s. l. followed by the Ferruginous Sands, Sandrock and Carstone. As access to this succession is a problem one must allocate enough time for the 12km walk. The cliffs are extremely unstable and major landslips and/or mud flows are a constant danger especially when they isolate sections of the beach and create hazards on a rising tide.

Chilton Chine, (SZ 410822), sample locality 1 (Figure 3).

Immediately west of the Chine the Sudmoor Point Sandstone is exposed in the low cliffs. The base is erosional and the lower part of the unit is conglomeratic: the clasts largely derived from calcretes eroded from the overbank mudstones. There is trough or planar cross-bedding in the upper part of the sandstone and some of the bedding planes show ripple cross-lamination. Dinosaur bones and dinosaur footprints have been recorded at this level. Above the sandstone and below the overlying Chilton Chine Sandstone is an intermittent plant debris bed that is located in an otherwise structureless purple/pink/green mudstone succession. This horizon is sample locality 1.

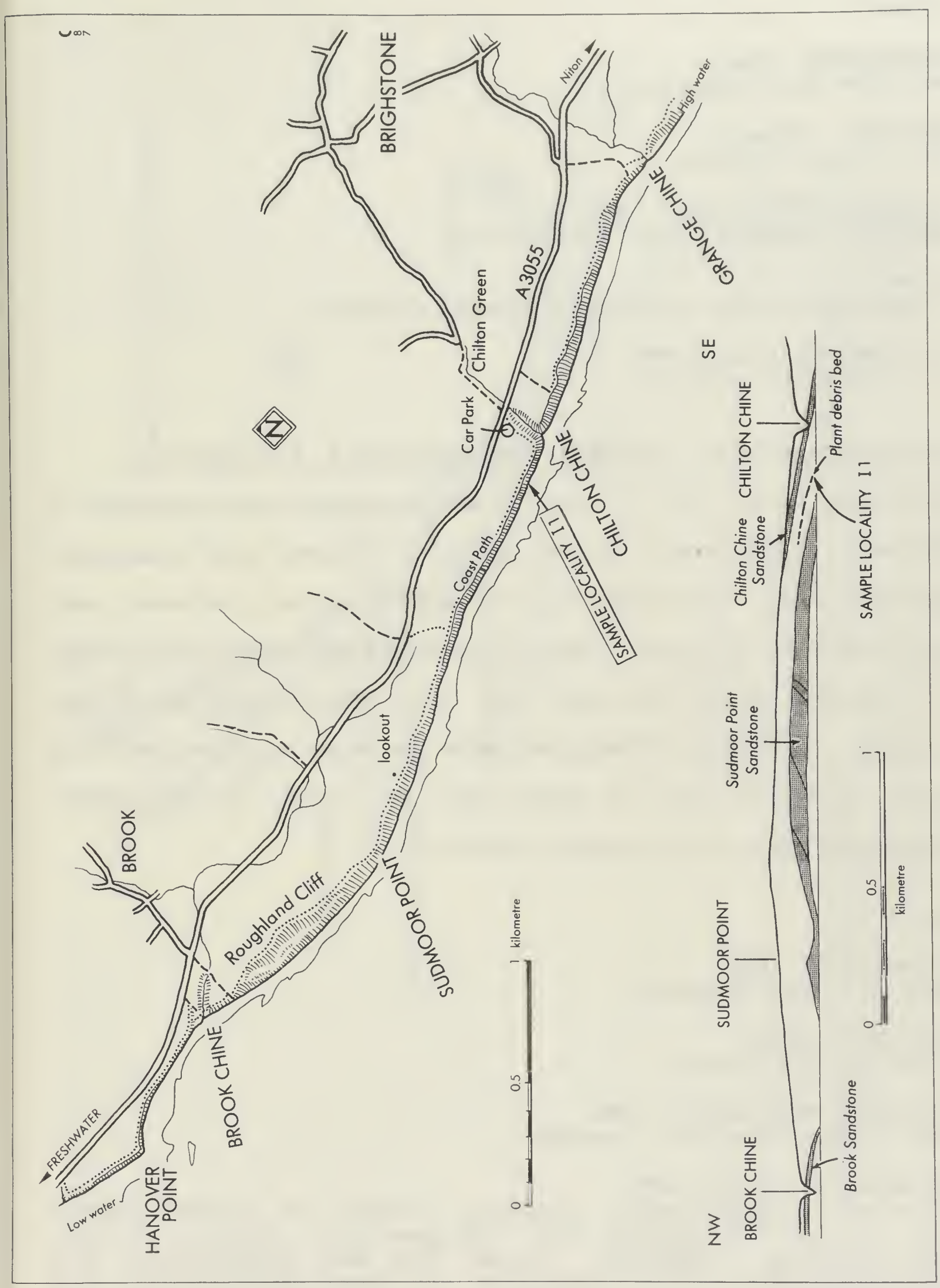


Figure 3. Chilton Chine (Sample Locality 1). The plant debris bed to be sampled is very low in the Wessex Formation (see Figure 5).

CH/MBH 1.

FORAMINIFERA (MBH)
No foraminifera recovered.

OSTRACODA (PPEW).
No ostracods recovered.

CALCAREOUS NANNOFOSSILS (JAB)
Watznueria barnesae (Black) Perch-Nielsen.

Comments
W.barnesae extremely etched and presumably reworked.

PALYNOMORPHS (DJB,JKL,AMM)
No palynomorphs recovered.

Compton Grange Chine, (SZ376842), sample locality 2, 3, (Figure 4).

At Hannover Point, south of the Chine, the Hannover Point Sandstone is exposed. The foreshore at the point is littered with araucarioid gynosperm logs. These are particularly abundant in the plant debris beds overlying the sandstone. Some are carbonised compressions while others are carbonate impregnations that still show annular rings and cellular structure. Just north of the point, below the second sandstone there is a plant debris bed rich in cycad cones and cones of the conifer Pseudofrenelopis. This is sample locality 2.

CG/MBH 1

FORAMINIFERA (MBH)
No foraminifera recovered.

OSTRACODA (PPEW)
No ostracods recovered.

CALCAREOUS NANNOFOSSILS (JAB)
No calcareous nannofossils recovered.

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Aequitriradites spinulosus (Cookson and Dettmann) Cookson and Dettman, Alisporites spp., Araucariacites australis Cookson, Callialasporites segmentatus (Balme) Sukh Dev, Ceratosporites sp., Cicatricosisporites sp. Classopollis sp. Costatoperforasporites sp., Couperisporites sp. cf. C.complexus (Couper) Pocock, Cyathridites minor Couper, Dictyophyllidtes sp., Eucommiidites sp. Exesipollenites tumulus Balme, Pilosisporites trichopapillosus (Thiergart) Delcourt and Sprumont, Reticulatisporites sp., Triporletes reticulatus (Pocock) Playford.

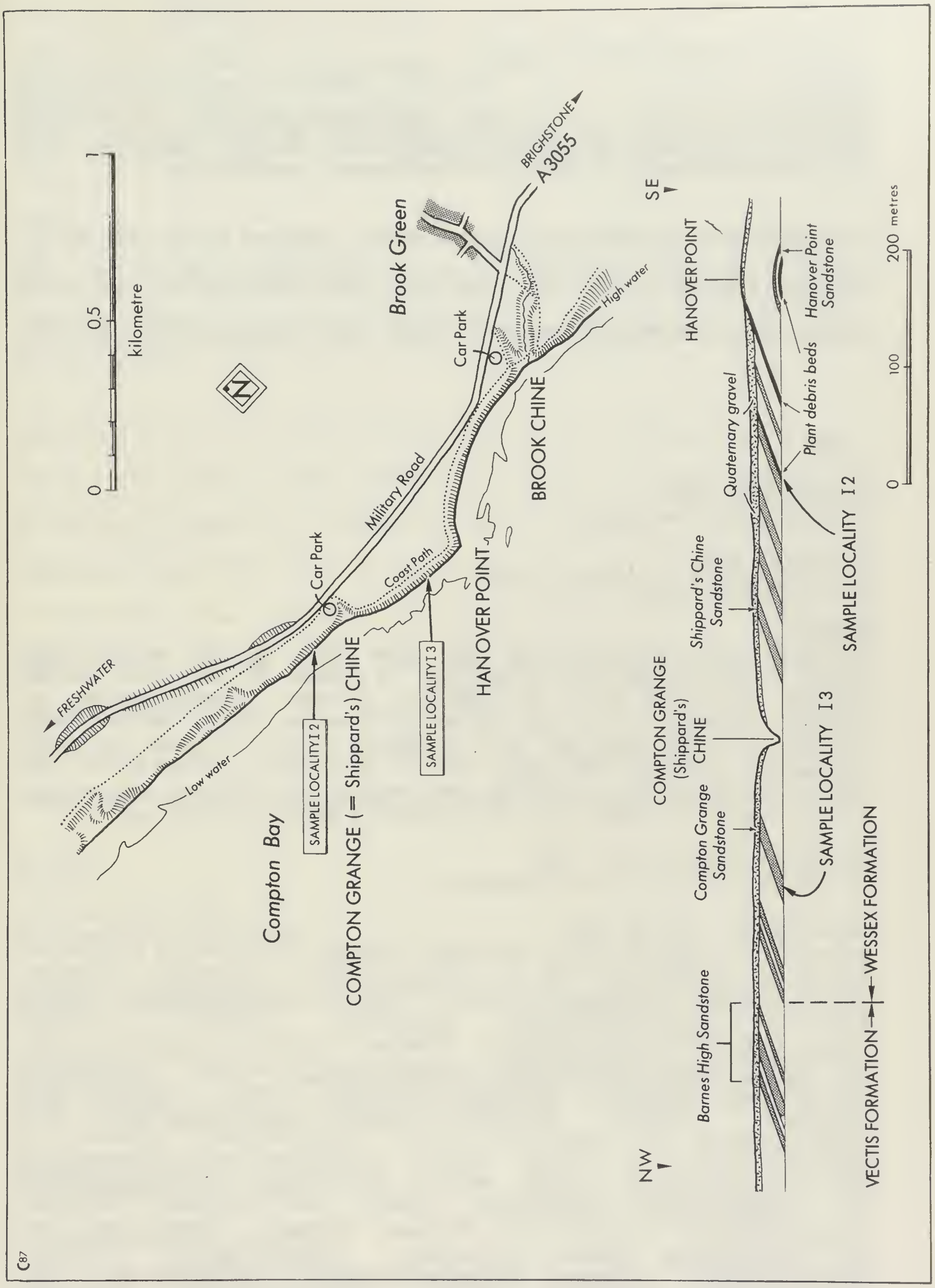


Figure 4. Compton Grange Chine = Shepherd's Chine (Sample Localities 2 and 3). Location map based on Stewart (1981b) and cliff profile based on Daley and Insole (1984). The abundant fossil wood can be found in the two plant debris beds immediately NW of Hannover Point.

Comments
Preparation dominated by unsorted land plant detritus. The miospore content is relatively low and microplankton are absent. Deposition in a non-marine environment is indicated (back-swamp, overbank mud?).

About 100m NW of the Chine the Compton Grange Sandstone can be seen and in the clays adjacent to this are a series of shell beds that are very close to the top of the Wessex Formation. These shell beds are sample locality 3.

CG/MBH 2.

FORAMINIFERA (MBH)
No foraminifera recovered.

OSTRACODA (RGC)
Theriosynoecum fittoni (Mantell).

Comments
T.fittoni ranges widely through the upper half of the Wealden sensu anglico. The monospecific assemblage is unusual for this genus and may indicate salinities near the species minimum. Theriosynoecum is normally regarded as a low salinity/freshwater genus; perhaps more euryhaline than Cypridea, but otherwise similar (Anderson (1985 and earlier) includes the genus in his so-called "S phase" group). The population contains not only males and females as carapaces and valves, but also rather abundant, and well-preserved early instar valves.

CALCAREOUS NANNOFOSSILS (JAB)
No calcareous nannofossils recovered.

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Aequitriradites spinulous (Cookson and Dettmann) Cookson and Dettmann, Alisporites spp., Araucariacites australis Cookson, Callialasporites dampieri (Balme) Norris, Ceratosporites parvus Brenner, Cerebropollenites mesozoicus (Couper) Nilsson, Cicatricosisporites australiensis (Cookson) Potonie, C.venustus Deak, C. spp., Concavissimisporites apigranulosus Doring, C.verrucosus Delcourt and Sprumont, Converrucosisporites sp., Coronatispora valdensis (Couper) Dettmann, Costato perforosporites sp., Crybelosporites sp. Cyathidites asper (Bolkhovitina) Dettmann, C. australis Couper, C. minor Couper, Cycadopites sp., Deltoidospora spp., Densoisporites velatus Weyland and Krieger, Dictyophyllidites sp., Foraminisporis asymmetricus (Cookson and Dettmann) Dettmann, F.wonthaggiensis (Cookson and Dettmann) Dettmann, Foveotriletes sp. cf. F.parviretus (Balme) Dettmann, F.subtriangularis Brenner, Gleicheniidites senonicus (Ross) Skarby, Klukisporites sp., Leptolepidites verrucatus Couper, Lycopodiumsporites marginatus Singh, L.sp., Osmundacidites wellmannii Couper, Parvisaccites radiatus Couper, Perinopollenites elatoides Couper, Pilosporites notensis Cookson and Dettmann, P.trichopapillosus (Thiergart) Delcourt and Sprumont, Podocarpidites dettmannii Kemp, Trilobosporites

apiverrucatus Couper, T.hannonicus (Delcourt and Sprumont) Potonie, Triporoletes radiatus (Dettmann) Playford.
Dinoflagellate cysts: Australisphaera sp..
Fungi: Pluricellaesporites psilatus Clarke.
Other algae: Celyphus rallus Batten, Schizosporis parvus Cookson and Dettmann.

Comments:
The occurrence of C.venustus and P.dettmannii indicates an age no older than Barremian. The predominance of bisaccate pollen, the abundance of well-preserved pteridophyte spores, the small amount of vitrinitic and inertinitic debris, and the occurrence of rare specimens of the dinocyst Australisphaera suggest deposition in fresh or low salinity waters under strong terrestial influence (near source vegetation).

Atherfield Point (SZ 451 790), sample localities 4-7 (Figure 5).

Access to the beach is down Shepherd's Chine which cuts through a section of the Vectis Formation. Immediately NW of the Chine is the Barnes High Sandstone Member. This is a coarsening-upwards sandstone unit that shows a transition from lenticular bedding near the base to large-scale cross-bedding at the top. There are wavy-rippled surfaces and some horizons are covered in Unio and/or Filosina. This sandstone appears to represent a barrier-bar or perhaps a small delta. The grey mudstones immediately (1.5 m) above the sandstone represent sample locality 4.

AP/MBH 1.

FORAMINIFERA (MBH)
No foraminifera recovered.

OSTRACODA (RGC)
Cypridea spinigera (J. de C. Sowerby) - 2 fragmentary left valves.

Comments
C. spinigera is only recorded from the Cypridea valdensis Zone and the upper part of the C.clavata Zone. Species of Cypridea are generally agreed to be low salinity/freshwater forms.

CALCAREOUS NANNOFOSSILS (JAB)
No nannofossils recovered.

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Acanthotriletes varispinosus Pocock, Aequitriradites spinulosus (Cookson and Dettmann) Cookson and Dettmann, Appendicisporites spp., Araucariacites sp., Baculatisorites comaumensis (Cookson) Potonie, Callialasporites Dampieri (Balme) Norris, C.segmentatus (Balme) Sukhdev, Cerebropollenites mesozoicus (Couper) Nilsson, Cicatricosisporites hughesii Dettmann,

C.venustus Deak, C. spp., Cingutriletes clavus Dettmann, Classopollis torosus (Reissinger) Couper, Clavatipollenites hughesii Couper emend. Kemp, Cyathidites asper (Bolkhovitina) Dettmann, C.minor Couper, Cycadopites sp., Deltoidospora spp., Exesipollenites tumulus Balme, Foraminisporis asymmetricus (Cookson and Dettmann) Dettmann, Foveotriletes sp. cf. F.parviretus (Balme) Dettmann, F.subtriangularis Brenner, Leptolepidites major Couper, L.sp, Lycopodiumsporites marginatus Singh, Osmundacidites wellmannii Couper, Parvisaccites radiatus Couper, Perinopollenites elatoides Couper, Pilosisporites trichopapillosus (Thiergart) Delcourt and Sprumont, Podacarpidites dettmanni Kemp, Sestrosporites pseudoalveolatus (Couper) Dettmann, Stereisporites sp., Trilobosporites apiverrucatus Couper, Triporoletes reticulatus (Pocock) Playford.
Dinoflagellate cysts: Dinocyst sp. A cf. Australisphaera sp..
Reworked elements: Chlamydophorella sp. Cribroperidinium sp. Gonyaulacysta jurassica.
Fungi: Pluricellaesporits psilatus Clarke.
Other algae: Botryococcus sp., Schizosporis parvus Cookson and Dettmann, S. reticulatus Cookson and Dettmann.

Comments
A late Barremian age is suggested by the presence of C.hughesii, C.venustus and P.dettmannii. An abundance of miospores and an abundance of microplankton apart from low numbers of Dinocyst sp. A (Australisphaera type) indicate that deposition occurred in waters that were weakly saline.

Between Shepherd's Chine and Atherfield Point the mudstones of the Shepherd's Chine Member are exposed. The dard grey mudstones are interbedded with pale grey siltstones. Some of the siltstones contain fronds of the fern Weichselia while many of the mudstones are crowded with ostracods. Thin limestones are entirely composed on the bivalve Filosina whle near the top of the succession some of the Fe-stained limestones are full of Ostrea. In the middle of the Shepherd's Chine Member one is able to find the classic 'Wealden Shale' ostracod beds - sample locality 5.

AP/MBH 3.

FORAMINIFERA (MBH)
No foraminifera recovered.

OSTRACODA (RGC)
Cypridea spinigera (J. de C. Sowerby), C.valdensis (J. de C. Sowerby), C. sp. indet..

Comments
C. spinigera is only recorded from the C.valdensis Zone. C. valdensis, far from being confined to its eponymous zone, ranges through the greater part of the Wealden. Species of Cypridea (= "C

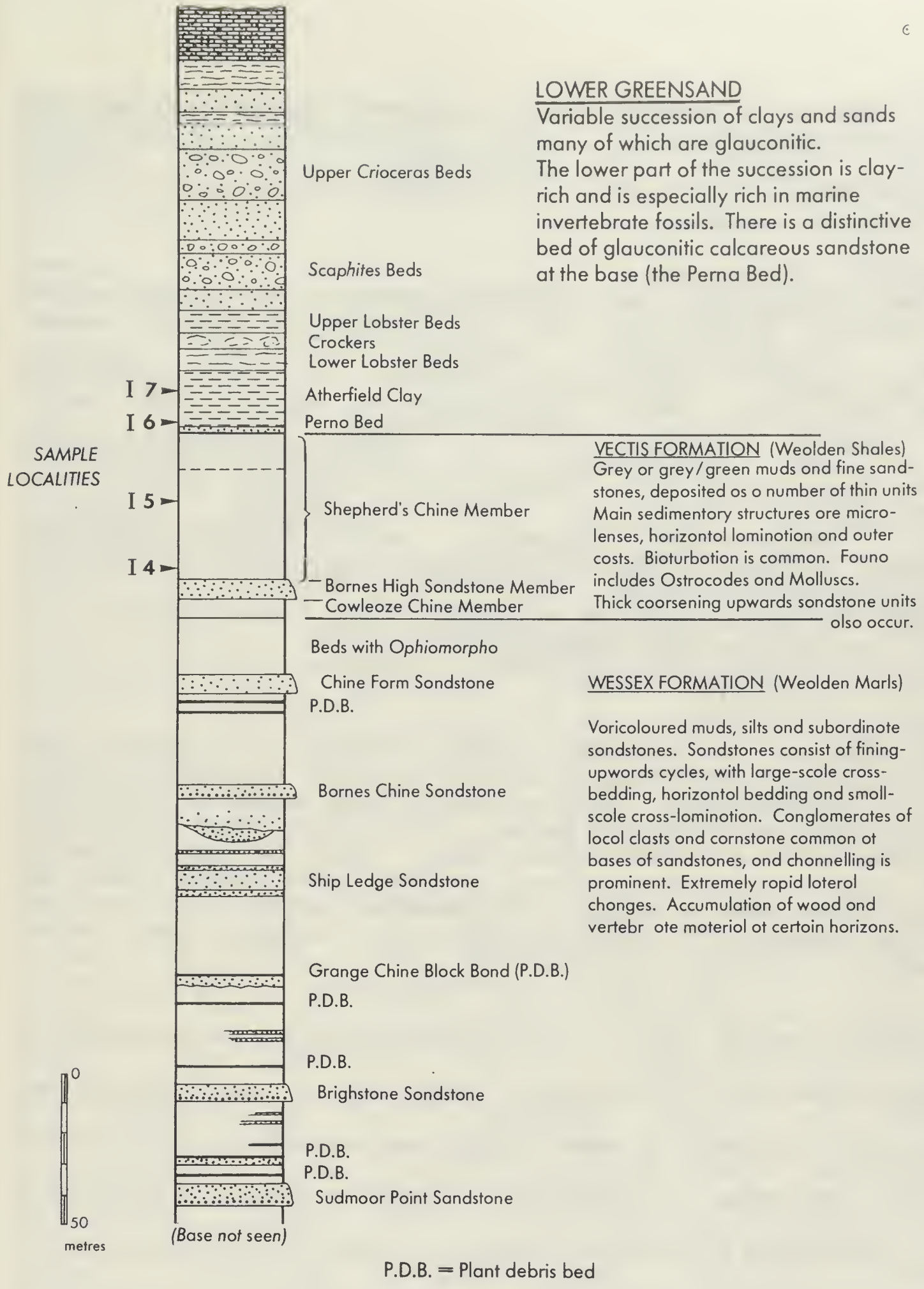

LOWER GREENSAND
Variable succession of clays and sands many of which are glauconitic.
The lower part of the succession is clay-rich and is especially rich in marine invertebrate fossils. There is a distinctive bed of glauconitic calcareous sandstone at the base (the Perna Bed).
Upper Crioceras Beds
Scaphites Beds
Upper Lobster Beds
Crockers
Lower Lobster Beds
I 7
Atherfield Clay
I 6
Perno Bed
SAMPLE LOCALITIES
I 5
I 4
Shepherd's Chine Member
Bornes High Sondstone Member
Cowleoze Chine Member
VECTIS FORMATION (Weolden Shales)
Grey or grey/green muds ond fine sandstones, deposited os o number of thin units
Main sedimentory structures ore micro-lenses, horizontol lominotion ond outer costs. Bioturbotion is common. Founo includes Ostrocodes ond Molluscs.
Thick coorsening upwards sondstone units olso occur.
Beds with Ophiomorpho
Chine Form Sondstone
P.D.B.
WESSEX FORMATION (Weolden Marls)
Voricoloured muds, silts ond subordinote sondstones. Sondstones consist of fining-upwords cycles, with large-scole cross-bedding, horizontol bedding ond smoll-scole cross-lominotion. Conglomerates of locol clasts ond cornstone common ot bases of sandstones, ond chonnelling is prominent. Extremely ropid loterol chonges. Accumulation of wood ond vertebr ote moteriol ot certoin horizons.
Bornes Chine Sondstone
Ship Ledge Sondstone
Grange Chine Block Bond (P.D.B.)
P.D.B.
P.D.B.
Brighstone Sondstone
P.D.B.
P.D.B.
Sudmoor Point Sandstone
0
50
metres
(Base not seen)
P.D.B. = Plant debris bed

Figure 5. Shepherd's Chine to Atherfield Point (Sample Localities 4-7). Lower part of section is based on Stewart (1981b); also shows position of Sample locality 1 in the plant debris bed immediately above the Sudmoor Point Sandstone.

phase" species of Anderson) are generally agreed to be low salinity/freshwater forms.

CALCAREOUS NANNOFOSSILS (JAB)
No nannofossils recovered.

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Alisporites spp., Appendicisporites tricornitatus Weyland and Griefeld, Araucariacites sp., Callialasporites dampieri (Balme) Norris, Cerebropollenites mesozoicus (Couper) Nilsson, Cicatricosisporites australiensis (Cookson) Potonie, Classopollis torosus (Reissinger) Couper, Clavatipollenites hughesii Couper emend. Kemp, Coronata valdensis (Couper) Dettmann, Cyathidites minor Couper, C.sp., Deltoidospora sp., Ephedripites multicostatus Brenner, Eucommiidites sp., Gleicheniidites senonicus (Ross) Skarby, Lycopodiumsporites marginatus Singh, Osmundacidites wellmannii Couper, Podocarpidites dettmannii Kemp, Polypodiaceoisporites foveolatus (Couper) Kemp, Verrucosisporites sp., Vitreisporis pallidus (Reissinger) Nilsson.
Dinoflagellate cysts: Cepadinium variabile Duxbury, Dinocyst sp. B.
Fungi: Pluricellaesporites psilatus Clarke.
Other algae: Schizosporis parvus Cookson and Dettmann.

Comments
A Barremian age is indicated by the occurrence of C.hughesii and E.multicostatus. The presence of the dinocyst C.variabile refines this to Late Barremian. The occurrence of large amounts of bacterially degraded (amorphous) organic matter of probably algal origin in association with low numbers of pteridophyte spores and bisaccate pollen grains suggest deposition occurred in a restricted lagoon which was temporarily deficient in oxygen. The common ocurrence of Dinocyst sp. B. and rare specimens of Cepadinium variabile indicate some saline influence.

At Atherfield Point there is a massive landslip and the succession is extremely difficult to interpret. Immediately to the south of the headland the 'Perna Bed' is seen at beach level overlain by the Atherfield Clay. The 'Perna Bed' - as indicated previously - contains a distinctive marine invertebrate fauna within a matrix of glauconite-rich calcareous sandstone. The clays immediately above the 'Perna Bed' contain lines of cementstone nodules and are quite rich in the zonal ammonites. Sample locality 6 is located 1.8m above the 'Perna Bed'.

AP/MBH 2.

FORAMINIFERA (MBH)
Citharina sp. aff. C.sparsicostata Reuss, Lenticulina atherfieldensis Crittenden, Ammobaculites obliquus Loeblich and Tappan, Ammobaculites sp. aff. A.reophacoides Bartenstein, Ammobaculites

subcretaceus Cushman and Alexander, Glomospirella gaultina (Berthelin), Haplophragmoides nonoininoides (Reuss), Haplophragmoides sp. aff. H.platus Loeblich, Psammosphaera sp., Reophax scorpiurus Montfort, Trochammina depressa Lozo, Trochammina sp. aff. T.latai Loeblich and Tappan.

Comments
Low diversity, poorly preserved, dominantly agglutinated fauna; may be due to decalcification of samples.

OSTRACODA (PPEW)
Virtually barren.

CALCAREOUS NANNOFOSSILS (JAB)
No nannofossils recovered.

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Acanthotriletes varispinosus, Aequitriradites spinulosus (Cookson and Dettmann) Cookson and Dettmann, Alisporites spp., Araucariacites sp., Baculatisporites sp. Callialasporites dampieri (Balme) Norris, Cerebropollenites mesozoicus (Couper) Nilsson, Cicatricosisporites hallei Delcourt and Sprumont, C.spp., Classopollis torosus (Reissinger) Couper, Coronatispora valdensis (Couper) Dettmann, Converrucosisporites sp., Cyathidites minor Couper, Deltoidospora sp., Exesipollenites tumulus Balme, Gleicheniidites senonicus (Ross) Skarby, Klukisporites pseudoreticulatus Couper, Lycopodiumsporites glebulentus Kemp, L.marginatus Singh, Parvisaccites radiatus Couper, P.rugulatus Brenner, Patellasporites distaverrucosus (Brenner) Kemp, Pilosisporites trichopapillosus (Thiergart) Delcourt and Sprumont.
Dinoflagellate cysts: Achomosphaera verdieri Below, Aptea plera Duxbury, A.securigera Davey and Verdier, Apteodinium maculatum Eisenack and Cookson, A.sp., Batioladinium micropodum (Eisnack and Cookson) Brideaux, Callaisphaeridium asymmetricum (Deflandre and Courteville) Davey and Williams, Cassiculosphaeridia sp., Cepadinium variabile Duxbury, Chlamydophorella sp. cf. C. discreta Clarke and Verdier, C.nyei Cookson and Eisenack, C.trabeculosa (Gocht) Davey, Cleistosphaeridium sp. Coronifera oceanica Cookson and Eisenack emend. May, Cribroperidinium sp. cf. C.edwardsii (Cookson and Eisenack) Davey, C.spp., Cyclonephelium brevispinatum (Millioud) Below, C.sp. cf. C.vannophorum Davey, Dingodinium cerviculum Cookson and Eisenack, Dissiliodinium globulum Drugg, Endoscrinium campanula (Gocht) Vozzhennikova, E.glabrum Duxbury, Exochosphaeridium phragmites Davey, Downie, Sarjeant and Williams, Florentina sp. cf. F.cooksoniae (Singh) Duxbury, F.interrupta Duxbury, Fromea complicata Brideaux, Gonyaulacysta? kleithria Duxbury, Heslertonia heslertonensis (Neale and Sarjeant) Sarjeant, emend. Duxbury, Hystrichosphaeridium recurvatum (White) Davey and Williams, Hystrichosphaerina schindewolfii Alberti, Kiokansium polypes (Cookson and Eisenack) Below, Kleithriosphaeridium simplicispinum (Davey and Williams) Davey, Meiourogonyaulax stoveri Millious, Muderongia pariata Duxbury, Occisucysta tertoria Duxbury, Odontochitina operculata (O. Wetzel) Deflandre and Cookson 1955, Oligosphaeridium asterigerum (Gocht) Davey and Williams, O.complex (White) Davey and Williams, Palaeoperidinium cretaceum Pocock emend. Davey, Pareodinia sp., Prolixosphaeridium parvispinum (Deflandre) Davey, Downie, Sarjeant and Williams, Protoellipsodinium clavulum Davey and Verdier emend. Duxbury, Pseudoceratium pelliferum Gocht, emend. Dorhofer and Davies, Pterodinium sp., Rhynochodiniopsis hyalodermopsis

(Cookson and Eisenack) Sarjeant, Spiniferites multibrevis (Davey and Williams) Below, S.ramosus (Ehrenberg) Loeblich and Loeblich, Subtilisphaera perlucida (Alberti) Jain and Millepied, Tanyosphaeridium boletum Davey, T.variecalamus Davey and Williams.
Other algae: Botryococcus sp., Micrhystridium spp., Pterospermella sp., Schizosporis reticulatus Cookson and Dettmann.
Misc.: foraminferal test linings.

Comments:
The following dinocyst species are characteristic of, and have a top range in the early Aptian: A.securigera, A.plera, G.?kleithria, C.variabile, H.heslertonensis (range top in forbesi Zone), P.pelliferum, E.glabrum, and F.interrupta. H.schindewolfii, S.perlucida and D.cerviculum are also common components of Aptian assemblages. A rich, high diversity dinocyst assemblage in conjunction with a substantial terrestrial input of miospores, vitrinitic and inertinitic detritus is indicative of a nearshore marine depositional environment. Proximity to a source of fresh water is also indicated by the occurrence of freshwater algae (Botryococcus and S.reticulatus). The common occurrence of acanthomorph acritarchs and inner linings of foraminifera provide further confirmation of shallow shelf conditions.

At the time of writing (Autumn, 1986) the Atherfield Clay is badly exposed and there is no continuously exposed section upwards through to the 'Crackers' - a siltstone with two layers of calcareous concretions (top and bottom). Sample locality 7 is therefore located 12 m above the base of the Atherfield Clay.

AP/MBH 4

FORAMINFERA (MBH).
Citharina sp. aff. C.sparsicostata (Reuss), Gavelinella barremiana Bettenstaedt, Gavelinella brielensis Malapris, Lenticulina atherfieldensis Crittenden, L. ex. gr. nodosa (Reuss), Ammobaculites obliquus Loeblich and Tappan, Dorothia gradata (Berthelin), Glomospirella gaultina (Berthelin), Haplophragmoides sp. aff. H.platus Leoblich, Lagenammina sp., Psammosphaera sp., Reophax minutus Tappan, Trochammina sp. aff. T.latai Loeblich and Tappan, T.sp., Verneuilinoides subfiliformis Bartenstein, Hedbergella infracretacea (Glaessner), Hedbergella hoterivica (Subbotina).

Comments
G.barremiana and G.brielensis are typical at this level in the UK and France. More open environment with planktonic foraminfera.

OSTRACODA (PPEW)
Virtually barren.

CALCAREOUS NANNOFOSSILS (JAB)
No nannofossils recovered.

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Acanthotriletes varispinosus Pocock, Alisporites spp., Araucariacites spp., Baculatisporites comaumensis (Cookson) Potonie, Callialasporites dampieri (Balme) Norris, Cerebropollenites mesozoicus (Couper) Nilsson, Cicatricosisporites australiensis (Cookson) Potonie, C.spp., Classopollis torosus (Reissinger) Couper, Clavifera triplex (Bolkhovitina) Bolkhovitina, Coronatispora valdensis (Couper) Dettmann, Crybelosporites sp. cf. C.vectensis Kemp, Cyathidites minor Couper, Deltoidospora spp., Exesipollenites tumulus Balme, Foveotriletes parviretus (Balme) Dettmann, F.subtriangularis Brenner, Gleicheniidites senonicus (Ross) Skarby, Klukisporites sp., Leptolepidites major Couper, Parvisaccites radiatus Couper, Perinopollenites elatoides Couper, Podocarpidites dettmannii Kemp, Trilobosporites apiverrucatus Couper, T.sp. cf. T.weylandii Doring.
Dinoflagellate cysts: Achomosphaera verdieri Below, Aptea plera Duxbury, A.securigera Davey and Verdier, Apteodinium maculatum Eisenack and Cookson, Australisphaera vitrea Duxbury, Batiacasphaera sp., Batioladinium micropodum (Eisenack and Cookson) Brideaux, Breedoxella caperata (Brideaux) Norris, Callaiosphaeridium asymmetriculum (Deflandre and Court Ville) Davey and Williams, Cassiculosphaeridia tazadensis Below, Cepadinium variabile Duxbury, Chlamydophorella discreta Clarke and Verdier, C.trabeculosa (Gocht) Davey, Cribroperidinium sp. cf. C.edwardsii (Cookson and Eisenack) Davey, C.sepimentum Neale and Sarjeant, C.spp., Cyclonephelium brevispinatum (Millioud) Below, C.sp. cf. C.distinctum Deflandre and Cookson, C.hystrix (Eisenack) Davey, C.sp. cf. C.vannophorum Davey, Dingogodinium cerviculum Cookson and Eisenack, Ellipsoidictyum imperfectum (Brideaux and McIntyre) Lentin and Williams, Endoscrinium sp. cf. E.glabrum Duxbury, Exochosphaeridium sp. cf. E.muelleri Yun, E.phragmites Davey, Downie, Sarjeant and Williams, Florentinia cooksoniae (Singh) Duxbury, F.interrupta Duxbury, Gonyaulacysta sp. cf. G.cretacea (Neale and Sarjeant) Sarjeant, G.?kleithria Duxbury, Hystrichodinium pulchrum Deflandre, Kiokansium polypes (Cookson and Eisenack) Below, Kleithriasphaeridium simplicispinum (Davey and Williams) Davey, Occisucysta sp. cf. O.sousensis Below, Odontochitina operculata (O.Wetziel) Deflandre and Cookson, Oligosphaeridium asterigerum (Gocht) Davey and Williams, O.complex (White) Davey and Williams, Palaeoperidinium cretaceum Pocock emend. Davey, Pareodinia ceratophora Deflandre emend. Gocht, Protocellipsodinium spinosum Davey and Verdier, Pseudoceratium pelliferum Gocht emend. Dorhofer and Davies, Pterodinium cingulatum (O.Wetzel) Below, Spiniferites magnoserratus (Cookson and Eisenack) Stover and Evitt, S.multibrevis (Davey and Williams) Below, S.ramosus (Ehrenberg) Loeblich and Loeblich, S.ramosus (Ehrenberg) Loeblich and Loeblich subsp. gracilis (Davey and Williams) Lentin and Williams, Subtilisphaera perlucida (Alberti) Jain and Millepied, Systematophora sp. cf. S.complicata Neale and Sarjeant, Tanyosphaeridium boletum Davey, T.salpinx, Norvick, Trichodinium sp., Wallodinium luna (Cookson and Eisnack) Lentin and Williams.
Other algae: Botryococcus sp., Eyrea nebulosa Cookson and Eisenack, Micrhystridium spp..
Misc.: foraminiferal test linings.

Comments
The following species suggest an early Aptian age: A.securigera, A.plera, C.sepimentum, A.vitrea, G.?kleithria, C.variabile, F.interrupta and P.pelliferum. The association of a diverse

dinoflagellate cyst assemblage with a moderate amount of land plant detritus, pteridophyte spores and a large number of bisaccate pollen grains is typical of a marine inner to mid-shelf deposit. Accumulation in relatively shallow water is also indicated by the occurrence of common foraminiferal test-linings and low numbers of acanthomorph acritarchs.

Compton Bay, (SZ365854) sample localities 8-17 (Figures 6-9)

Exposed in the wide sweep of Compton Bay is an almost continuous section of Lower to Upper Cretaceous strata (figure 6) ranging from the Ferruginous Sands to the Middle Chalk. The succession has been described by Jukes-Browne and Hill (1900, 1901, 1904), White (1921), Kennedy (1969), Carter and Hart (1977) and Daley and Insole (1984). Walking northwards from Compton Grange Chine the area occupied by the Atherfield Clay is a massive landslip (now almost reaching the main road) but above this in the succession there is a rather featureless cliff of the Ferruginous Sands. Few of the subdivisions recognised by Fitton (1845), Casey (1961) and Daley and Insole (1984) for the succession south-east of Atherfield Point can be identified and it is only near the now-abandoned Compton Chine access point that distinctive sedimentological features can be seen. At this locality, some metres NW of the old steps, there is a distinctive bed of glauconitic sandstone that has an intensely bioturbated (Thalassinoides) upper surface. This glauconitic sandstone is sample locality 8.

CB/MBH 10.

FORAMINIFERA (MBH)
Sample barren - in previous work Cushman found Arenobulimina macfadyeni.

Comments:
Shallow-water marine environment on the basis of the trace fossil assemblage.

OSTRACODA (PPEW)
No ostracods recovered.

CALCAREOUS NANNOFOSSILS (JAB)
No nannofossils recovered.

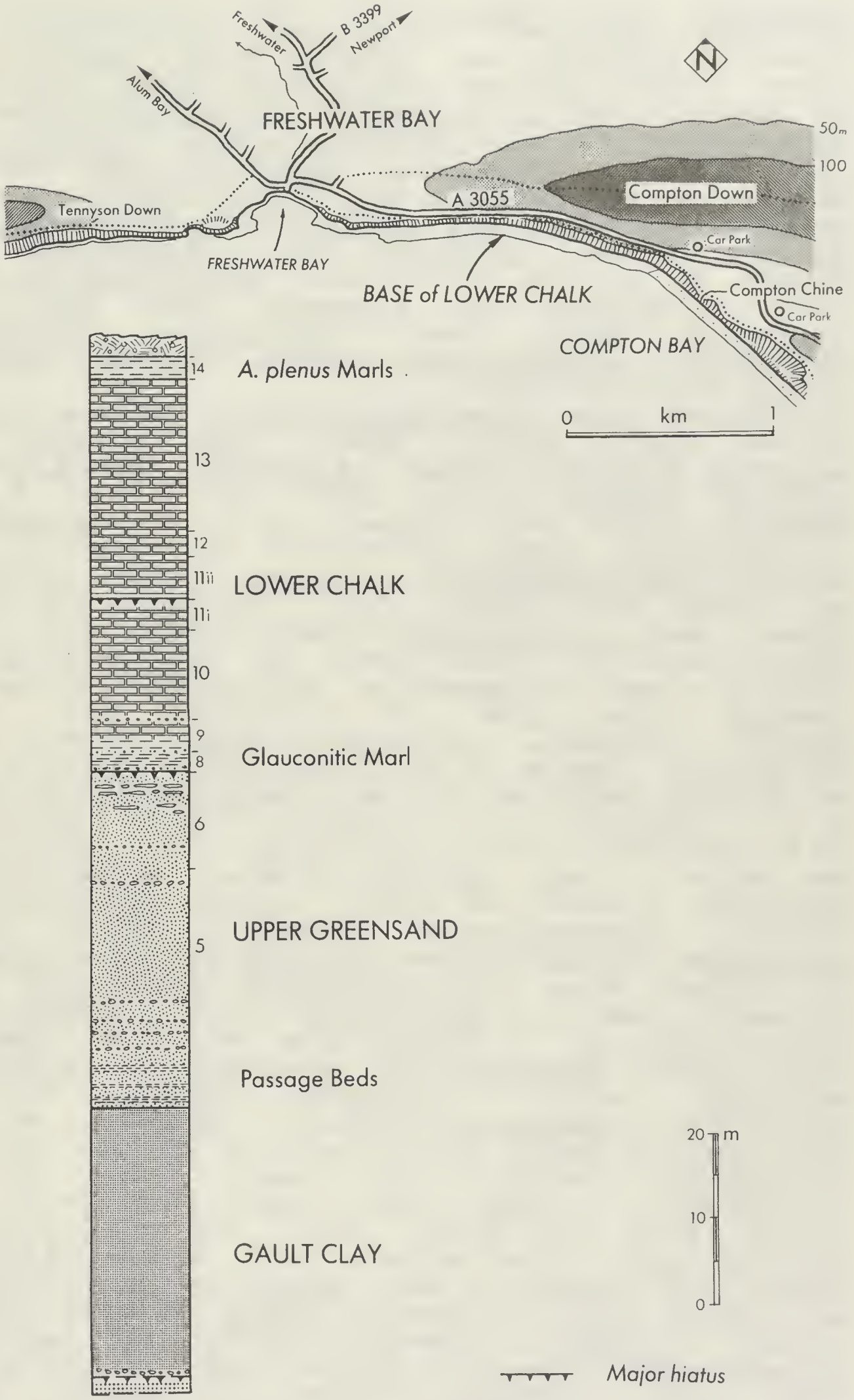


Figure 6. Compton Bay (Sample Localities 8-17). The zonal numbers refer to foraminiferal zones described in Carter and Hart (1977).

PALYNOMORPHS (DJB,JKL,AMM)

Miospores: Alisporites spp., Cerebropollenites mesozoicus (Couper) Nilsson, Cicatricosisporites brevilaesuratus Couper, C.hallei Delcourt and Sprumont, C.spp., Classopollis torosus (Reissinger) Couper, Concavissimisporites sp., Converrucosisporites exquisitus Singh, Crybelosporites vectensis, Kemp, Cyathidites asper (Bolkhovitina) Dettmann, C.minor Couper, Deltoidospora spp., Exesipollenites tumulus Balme, Foveotriletes subtriangularis Brenner, Gleicheniidies apilobatus Brenner, G.bulbosus Kemp, G.circinidites (Cookson) Dettmann, G. Senonicus (Ross) Skarby, Lycopodiumsporites clavatoides Couper, L.glebulentus Kemp, L.margnatus Singh, Monosulcites sp., Parvisaccites radiatus Couper, Podocarpidites dettmanni Kemp, Sestrosporites pseudoalveolatus (Couper) Dettmann, Vitreisporites pallious (Reissinger) Nilsson.

Dinoflagellate cysts: Achomosphaera neptunii (Eisenack) Davey and Williams, Aldorfia vectensis Duxbury, Aptea polymorpha Eisenack, Apteodinium granulatum Eisenack, A.maculatum Eisenack and Cookson, Ascodinium incomptum (Duxbury) Lentin and Williams, A.incorporeum (Duxbury) Lentin and Williams, A.sp., Batiacasphaera sp., Callaiosphaeridium asymmetricum (Deflandre and Courteville) Davey and Williams, Cassiculosphaeridia reticulata Davey, Chlamydophorella nyei Cookson and Eisenack, C.sp., Cleistophaeridium huguoniotii (Valensi) Davey, C.multispinosum (Singh) Brideaux, C.sp., Coronifera oceanica Cookson and Eisenack emend. May, Cribroperidinium orthoceras (Eisenack) Davey, Cyclonephelium brevispinatum (Millioud) Below, C.maugaad Below, C.sp. cf. C.vannophorum Davey, Dingodinium albertii Sarjeant, Discorsia nanna (Davey) Duxbury, Dissilodinium globulum Drugg, Ellipsoidictyum imperfectum (Brideaux and McIntyre) Lentin and Williams, Exochosphaeridium phragmites Davey et al., Florentinia sp. cf. F.abjuncta Duxbury, F.mantellii (Davey and Williams) Davey and Verdier, F.radiculata (Davey and Williams) Davey and Verdier, Fromea complicata Brideaux, Gonyaulacysta sp. cf. G.helicoidea (Eisenack and Cookson) Sarjeant, Hystrichodinium pulchrum Deflandre, Hystrichosphaerina schindwolfii Alberti, Impagidinium alectrolophum (Sarjeant) Stover and Evitt, Kiokansium polypes (Cookson and Eisenback) Below, Kleithriasphaeridium simplicispinum (Davey and Williams) Davey, Leberidocysta sp., Leptodinium sp., Meiourogonyaulax sp. cf. M.psora Davey and Verdier, Membranosphaera sp.A. Davey, Microdinium sp. cf. M.setosum Sarjeant, Nummus monoculatus Morgan, Occisucysta sousensis Below, O.sp., Odontochitina operculata (O.Wetzel) Deflandre and Cookson, Oligosphaeridium complex (White) Davey and Williams, O.poculum Jain, O.pulcherrimum (Deflandre and Cookson) Davey and Williams, Palaeoperidinium cretaeum Pocock, emend. Davey, Proteollipsodinium clavulum Davey and Verdier emend. Duxbury, Pterodinium sp., Rhynochodiniopsis aptiana Deflandre emend. Sarjeant, R.hyalodermopsis (Cookson and Eisenack) Sarjeant, Spiniferites magnoserratus (Cookson and Eisenack) Stover and Evitt, S.ramosus (Ehrenberg) Loeblich and Loeblich, S.ramosus (Ehrenberg) Loeblich and Loeblich subsp. grenomembranaceous (Davey and Williams) Lentin and Williams, S.ramosus subsp. ramosus (Ehrenberg) Loeblich and Loeblich, Stephodinium spinulosum Duxbury, Subtilisphaera perlucida (Alberti) Jain and Millepied, Surculosphaeridium longifurcatum (Firtion) Davey, Downie, Sarjeant and Williams, S.trunculum Davey, Systematophora complicata Neale and Sarjeant, Tanyosphaeridium variecalamus Davey and Williams, Wallodinium luna (Cookson and Eisenack) Lentin and Williams.

Other algae: Cymatiosphaera sp., Eyrea nebulosa Cookson and

Eisenack, Micrhystridium spp., Pterospermella sp., Schizosporis parvus Cookson and Dettmann, Veryhachium sp.

Comments
A late Aptian age is indicated by C.vectensis and G.bulbosus and the dinocysts A.neptunii, A.vectensis, A.incorporeum, A.polymorpha, D.albertii and S.trunculum (which has a range top in the jacobi Zone). A coastal environment in proximity to a source of vegetation is indicated by the abundance of land-plant debris including large cuticular, inertinitic and vitrinitic fragments, abundant miospores and a diverse dinocyst assemblage.

Above the Ferruginous Sands lies the Sandrock Series, which in ascending order, comprises Fe-stained sandstones, inter-laminated blue clay and white sand, bright yellow sandstone, and blue silts with small pebbles and occasional lignite. These silts are overlain by a prominent pebble bed that grades up into a dark brown coarse sandstone - the Carstone. Above the eroded top of this sandstone there is another pebble horizon which forms the basal bed of the Gault Clay. Recent landslips have almost totally obscured this section although material can be collected from the fresh falls. Such samples cannot be located stratigraphically with any degree of accuracy.

Following the bay round to a more westerly trend, almost at the beginning of the high cliffs, a section can be found that shows the transition from the Gault Clay to the Upper Greensand (figure 7). Exposed on the foreshore are the dark blue siltstones of the Gault Clay; sample locality 9.

CB/MBH 8.

FORAMINIFERA (MBH)
Ammobaculites subcretacea Cushman and Alexander, Arenobulimina chapmani Cushman, Dorothia gradata (Berthelin), Dorothia gradata var. dispansa (Chapman), Eggerellina mariae Ten Dam, Hormosina lagenarium (Berthelin), Reophax spp., Tritaxia singularis Magniez-Jannin, Citharinella pinnaeformis (Chapman), Frondicularia cordai Reuss, Gavelinella intermedia (Berthelin), G.reussi (Khan), G.tormarpensis Brotzen, Globulina lacrima Reuss, Lenticulina ex. gr. gaultina (Berthelin), Lingulogavelinella albiensis Malapris, Marginulina bronni (Roemer), M.jonesi (Reuss), Nodosaria obscura Reuss, N.orthopleura Reuss, N.paupercula Reuss, N.proboscidea Reuss, N.sceptrum Reuss, Saracenaria italica Defrance, Vaginulina ex. gr. kochii Roemer,

Guembilitria harrisi Tappan, Hedbergella infracretacea (Glaessner), H.planispira (Tappan).

Comments
A.chapmani and C.pinnaeformis indicate a Late Albian age. Rare planktonic species, only shallow-water morphotypes.

OSTRACODA (PPEW)
Cytherella ovata (Roemer), Cornicythereis larivourensis (Damotte and Grosdidier).

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae (Black), Perch-Nielsen, Ellipagelosphaera ovata (Bukry) Black, Zeugrhabdotus erectus (Deflandre in Deflandre and Fert) Reinhardt, Prediscosphaera avitus (Black) Perch-Nielsen, Eprolithus floralis (Stradner) Stover, Eiffellithus turriseiffelii (side view) (Deflandre in Deflandre and Fert) Reinhardt, Staurolithites crux (Deflandre and Fert) Caratini, Rhagodiscus asper (Stradner) Reinhardt, Rhagodiscus achlyostaurion (Hill).

Comments:
Age diagnostic fossils - E.floralis (martinoides Zone, Upper Aptian - Lower Campanian), ?E.turriseiffelii (inflatum Zone, Upper Albian - Maastrichtian), R.achlyostaurion (martinoides Zone, Upper Aptian - lata Zone, Mid Turonian). Poor preservation - coccoliths sparse.

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Alisporites spp., Cicatricosisporites sp., Cythadites minor Couper, Klukisporites pseudoreticulatus Couper, Liliacidites sp.
Dinoflagellate cysts: Achomosphaera crassipellis (Deflandre and Cookson) Stover and Evitt, A.ramulifera (Deflandre) Evitt, Adnatosphaeridium sp., Apteodinium grande Cookson and Hughes, A.maculatum Eisenack and Cookson, Callaiosphaeridium asymmeticum (Deflandre and Courteville) Davey and Williams, Chatangiella granulifera (Manum) Lentin and Williams, Chlamydophorella sp., Cleistophaeridium huguoniotii (Valensi) Davey, C.multispinosum (Singh) Brideaux, Cribroperidinium edwardsii (Cookson and Eisenack) Davey, Cyclonephelium distinctum Deflandre and Cookson, C.hystrix (Eisenback) Davey, C.membraniphorum Cookson and Eisenack, C.vannophorum Davey, Dapsilidinium? pumilum (Davey and Williams) Lentin and Williams, Diconodinium sp., Ellipsoidictyum sp., Ellipsodinium rugulosum Clarke and Verdier, Endoscrinium campanula (Gocht) Vozzhenikova, Exochosphaeridium phragmites Davey, Downie, Sargeant and Williams, Florentinia ferox (Deflandre) Duxbury, F.mantellii (Davey and Verdier, F.radiculata (Davey and Williams) Davey and Verdier, Gonyaulacysta cassidata (Eisenack and Cookson) Sarjeant, Hystrichodinium pulchrum Deflandre, Hystrichostrogylon membraniforum Agelopoulos, Kiokansium polypes (Cookson and Eisenack) Below, Litosphaeridium arundum (Eisenack and Cookson) Davey, Mahgrebinia perforata (Clarke and Verdier) Below, Microdinium ornatum Cookson and Eisenack, M.setosum Sarjeant, Oligosphaeridium asterigerum (Gocht) Davey and Williams, O.complex (White) Davey and Williams, Palaeoperidinium cretaceum Pocock emend. Davey, Pervosphaeridium sp. cf. P.cenomaniense (Norvick) Below, P.trunctum (Davey) Below, Prolixosphaeridium parvispinum (Deflandre) Davey, Downie, Sargeant and Williams, Protoellipsodinium spinocristatum Davey and Verdier, Pterodinium cingulatum (O.Wetzel) Below, Spiniferites multibrevis (Davey and Williams) Below, S.ramosus

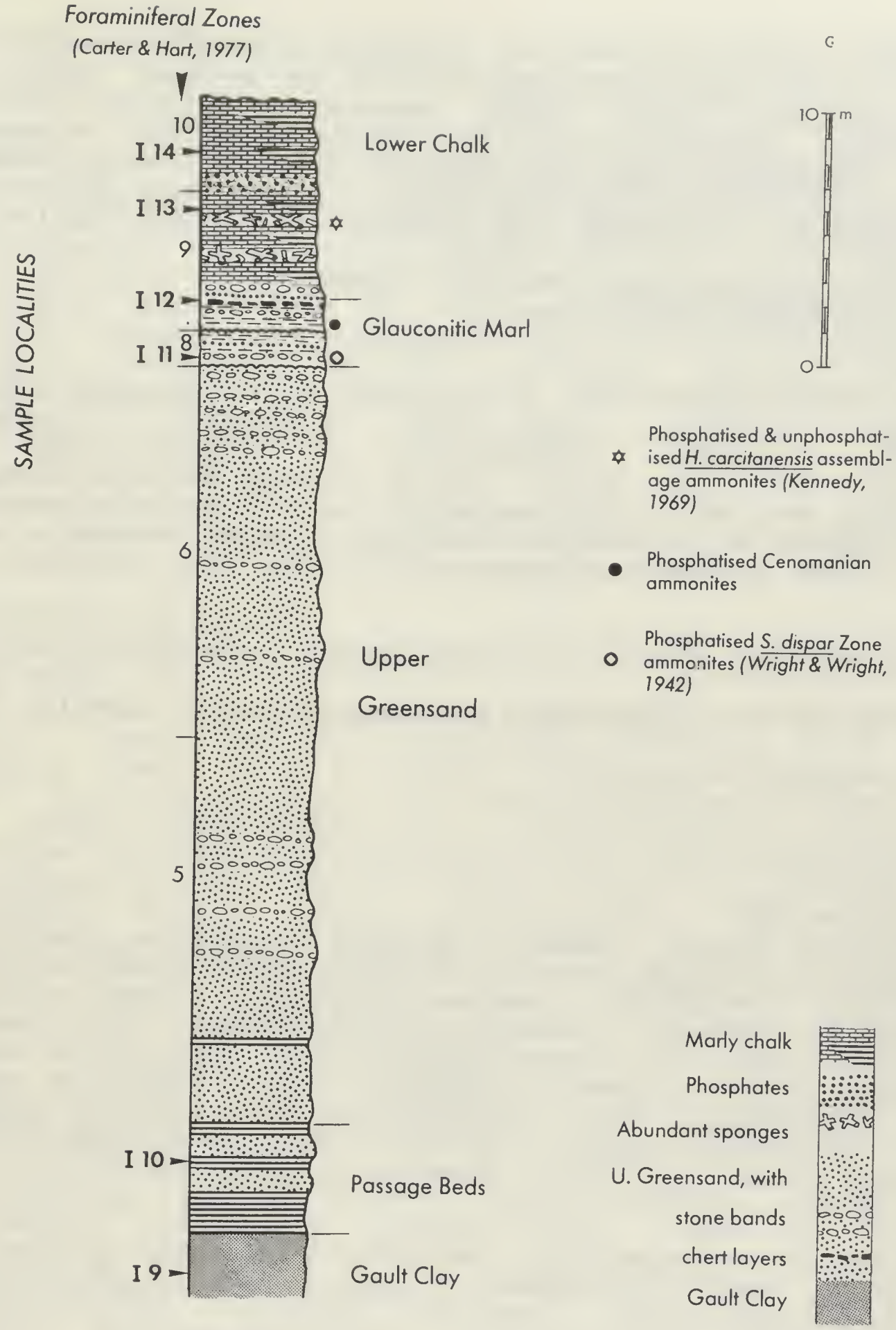


Figure 7. Compton Bay (Sample Localities 9-14). The Gault Clay and Upper Greensand succession is poorly exposed in the bay and only limited sampling is possible.

(Ehrenberg) Loeblich and Loeblich, S.ramosus (Ehrenberg) Loeblich and Loeblich subsp. granomembranaceous (Davey and Williams) Lentin and Williams, S.ramosus subsp. ramosus (Ehrenberg) Loeblich and Loeblich, Stephodinium coronatum Deflandre, Stiphrosphaeridium anthophorum Davey, Surculosphaeridium longifurcatum (Firtion) Davey, Downie, Sarjeant and Williams, Tanyosphaeridium variecalamus Davey and Williams, Trichodinium sp., Wallodinium luna (Cookson and Eisenack) Lentin and Williams.
Other algae: Eyrea nebulosa Cookson and Eisenack.
Misc.: foraminiferal test linings.

Comments
A late Albian-Vraconian age is suggested by the following species: X.alatum, M.ornatum, C.granulifera, M.perforata, E.rugulosum, A.grande, L.arundum, C.membaniphorum and P.spinocristatum. The occurrence of a rich, diverse dinocyst assembage dominated by chorate morphotypes, very few miospores and only a moderate amount of associated organic detritus which consists of inertinite fragments, reflect a middle to outer shelf environment of deposition.

The Passage Beds themselves (Fig.7) yield a distinctive foraminiferal assemblage of Albian age although the preservation is generally poor. This is sample locality 10.

CB/MBH 9

FORAMINIFERA (MBH)
Arenobulimina chapmani Cushman, Hormosina lagenarium (Berthelin), Labrospira nonioninoides (Reuss) Tritaxia singularis Magniez-Jannin, Citharinella pinnaeformis (Chapman), Edithaella sessilis Fuchs, Gavelinella intermedia (Berthelin), Gavelinella reussi (Khan), Globulina lacrima Reuss, Lenticulina ex. gr. gaultina (Berthelin), Marginulina bronni (Roemer), M.jonesi (Reuss), Nodosaria obscura Reuss, N.orthopleura Reuss, N.proboscidea Reuss, Ramulina aculeata Wright, Saracenaria italica Defrance, Tristix excavatum (Reuss), Vaginulina ex. gp. kochii Roemer, Guembilitria harrisi Tappan.

Comments:
A.chapmani and C.pinnaeformis indicate a Late Albian age. Very rare planktonic taxa (1 species), environment gradually becoming clastic-dominated.

OSTRACODA (PPEW)
Cytherella ovata (Roemer), *Schuleridea jonesiana (Bosquet), Cytherella cf. C.truncata (Bosquet), Cytherella ovata (Roemer), Cytherella gruendeli Weaver, Cytherella cf. C.contracta van Veen, *Mandocythere harrisiana (Jones), *Cornicythereis larvivourensis (Damotte and Grosdidier), *Cythereis hirsuta Damotte and Grosdidier.

Comments
Age diagnostic fossils - Those marked with *. See ranges in Weaver (1982) Fauna restricted, particularly in small sized species. More species should be obtainable with care.

CALCAREOUS NANNOFOSSILS (JAB)
Eiffellithus turriseiffelii (Deflandre in Deflandre and Fert) Reinhardt, Watznaueria barnesae (Black) Perch-Nielsen, Rhagodiscus angustus (Stradner) Reinhardt, Cribrosphaerella ehrenbergii (Arkhangelsky) Deflandre in Piveteau, Rotellapillus laffittei (Noel) Noel, Scapholithus fossilis Deflandre and Pert, Prediscosphaera avitus (Black) Perch-Nielsen, Staurolithites crux (Deflandre in Deflandre and Fert) Caratini, Zeugraphdotus erectus (Deflandre in Deflandre and Fert) Reinhardt, Thoracosphaera sp., Retecapsa crenulata (Bramlette and Martini) Grun in Grun and Allemann, Biscutum ellipticum (Gorka) Grun and Allemann, Ellipsagelosphaera ovata (Bukry) Black, Tranolithus orionatus (Reinhardt) Reinhardt, Eprolithus floralis (Stradner) Stover, Chiastozygus litterarius (Gorka) Manivit, Corollithion exiguum Stradner.

Comments
Age diagnostic fossils - E.turriseiffelii (inflatum Zone, Upper Albian - Maastrichtian), E.floralis (martinoides Zone, Upper Aptian - Lower Campanian). Poor preservation - coccoliths sparse.

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: bisaccates, Deltoidospora sp., Gleicheniidites senonicus (Ross) Skarby.
Dinoflagellate cysts: Achomosphaera crassipellis (Deflandre and Cookson) Stover and Evitt, A.ramulifera (Deflandre) Evitt, Aptea eisenackii (Davey) Davey and Verdier, Apteodinium grande Cookson and Hughes, A.maculatum Eisenack and Cookson, Ascodinium scabrosum Cookson and Hughes, Batiacasphaera sp., Callaiosphaeridium asymmetricum (Deflandre and Courteville) Davey and Williams, Cassiculosphaeridia sp., Chlamydophorella nyei Cookson and Eisenack, Cleistosphaeridium huguoniotii (Valensi) Davey, C.multispinosum (Singh) Brideaux, Coronifera oceanica Cookson and Eisenack emend. May, Cribroperidinium edwardsii (Cookson and Eisenack) Davey, Cyclonephelium brevispinatum (Millioud) Below, C.compactum Deflandre and Cookson, C.distinctum Deflandre and Cookson, C.vannophorum Davey, Endoscrinium campanula (Gocht) Vozzhennikova, Epelidosphaeridia spinosa (Cookson and Hughes) Davey, Exochosphaeridium phragmites Davey et al., Florentina mantellii (Davey and Williams) Davey and Verdier, F. radiculata (Davey and Williams) Davey and Verdier, F.stellata (Maier) Below, Gonyaulacysta cassidata (Eisenack and Cookson) Sarjeant, Hystrichodinium pulchrum Deflandre, Hystrichostrogylon membraniphorum Agelopoulos, Isabelidinium globosum (Davey) Lentin and Williams, Leberidocysta deflocata (Davey and Verdier) Stover and Evitt, Litosphaeridium arundum (Eisenack and Cookson) Davey, Microdinium crinitum Davey, M.setosum Sarjeant, Odontochitina operculata (O.Wetzel) Deflandre and Cookson, Oligosphaeridium asterigerum (Gocht) Davey and Williams, O.complex (White) Davey and Williams, O.poculum Jain, Palaeoperidinium cretaceum Pocock emend. Davey, Pervodsphaeridium pseudhystrichodinium (Deflandre) Yun, P.truncatum (Davey) Below, Psaligonyaulax deflandrei Sarjeant emend. Sarjeant, Pterodinium cingulatum (O. Wetzel) Below subsp. granulatum Clarke and Verdier, Sentusidinium sp., Spinidinium sp. cf. S.vestitum Brideaux, S.sp., Spiniferites ramosus (Ehrenberg) Loeblich and Loeblich, S.ramosus subsp. ramosus (Ehrenberg) Loeblich and Loeblich, S.wetzelii (Deflandre) Sarjeant, Stephodinium coronatum Deflandre, Stiphrosphaeridium anthophorum Davey, Surculosphaeridium longifurcatum (Firtion) Davey, Downie, Sarjeant and Williams, Trichodinium casterea (Deflandre) Clarke and Verdier.

Other algae: Micrhystridium sp., Veryhachium sp..
Misc.: foraminiferal linings.

Comments:
A Late Albian-Vraconian age is indicated by the occurrence of P.deflandrei, E.spinosa, A.grande, S.sp. cf. S.vestitum, L.defloccata and L.arundum. A relatively diverse dinocyst assemblage in conjunction with a negligible content of degraded miospores and a moderate amount of largely inertinitic debris, suggests a marine site of deposition at some distance from land. Some terrestrial influence is reflected by the presence of rare structured vitrinitic phytoclasts and large cuticular fragments.

Beyond this point the beach becomes difficult to traverse and access is controlled by the tide. About 300 m west of this point, after crossing most of the Upper Greensand outcrop, there is a prominent bluff of very glauconitic sandstone. This point is always cut off first by the rising tide and the chalk succession beyond this point must never be attempted on anything other than a falling tide.

The marked erosional base to the Glauconitic Marl indicates a distinctive change to a well-preserved, high diversity, fauna and flora. Macrofossils are abundant, though phosphatised, and there is a complete admixture of Early Cenomanian zonally distinctive ammonites (as shown in Figure 7). Above the very glauconite-rich basal sandstone there is a gradual progression upwards (Figure 8) into more typical Lower Chalk, which in its lower part is characterised by limstone/marl cycles. Many of the limestones are crowded with the sponge Exanthesis labrosus. Sample 11 is at the base of the Glauconitic Marl.

CB/MBH 2.

FORAMINIFERA (MBH)
Arenobulimina advena (Cushman), A.anglica Cushman, A.sp., Praebulimina sp., Gavelinella cenomanica (Brotzan), G.reussi (Khan), Lenticulina ex. gp. gaultina (Berthelin), Guembilitria harrisi Tappan, Hedbergella delrioensis (Carsey), Heterohelix moremani (Cushman).

Comments
G.cenomanica and A.advena indicate an Early Cenomanian age. Very poor

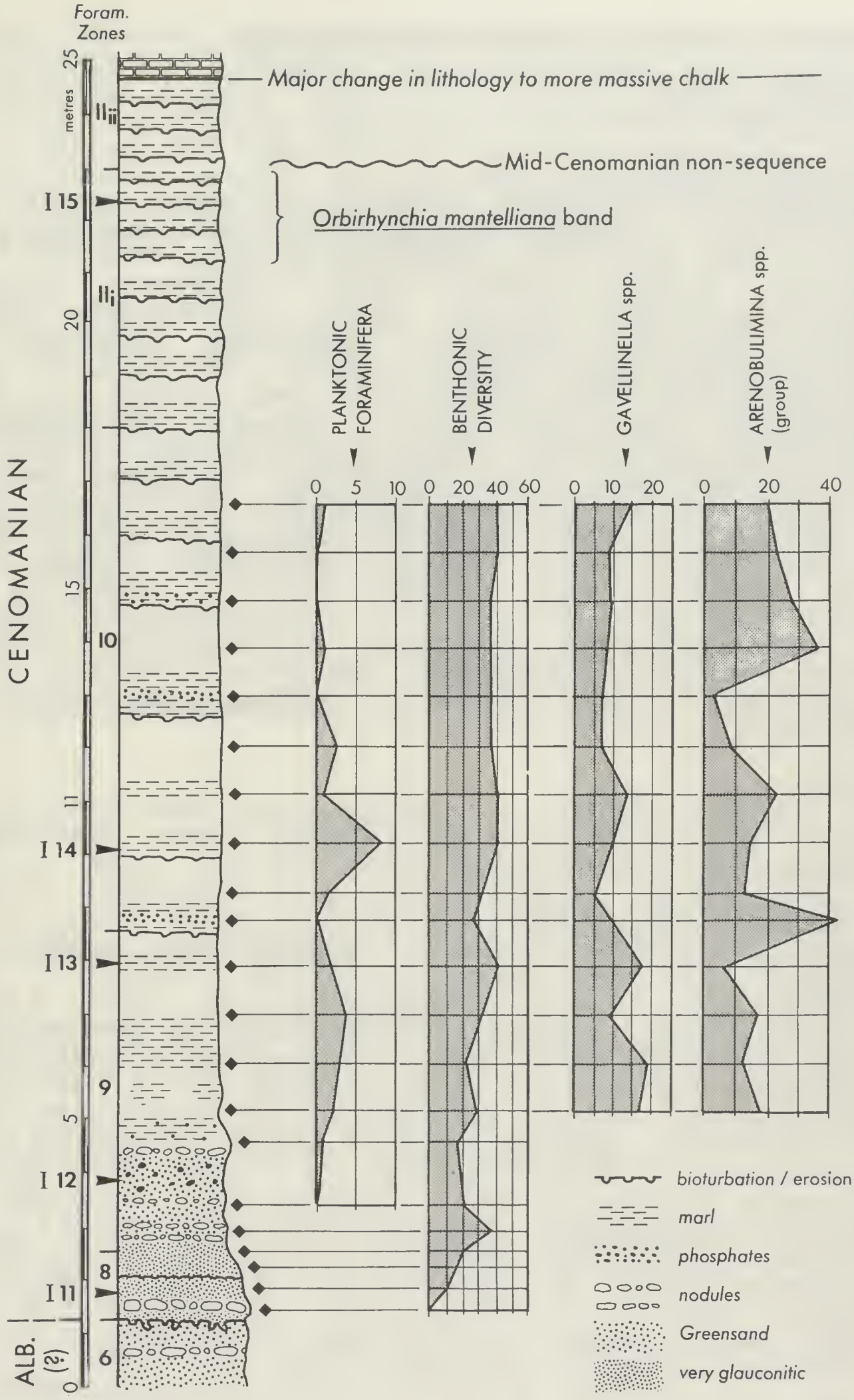


Figure 8. Compton Bay (Sample Localities 11-15). The early to mid-Cenomanian succession of Compton Bay is accessible west of the prominent point that marks the Glauconitic Marl at sea level.

planktonic assemblage; shallow-water morphotypes.

OSTRACODA (PPEW)
No ostracods recovered.

CALCAREOUS NANNOFOSSILS (JAB)
Lithraphidites carniolensis Deflandre, Watznaueria barnesae (Black), Perch-Nielsen, Broinsonia signata (Noel) Noel, Biscutum ellipticum (Gorka), Grun and Allemann, Tranolithus orionatus (Reinhardt) Reinhardt, Eprolithus floralis (Stradner) Stover, Rhagodiscus achlyostaurion (Hill) Glaukolithus compactus (Bukry) Perch-Nielssen, Rhagodiscus angustus (Stradner) Reinhardt, Chiastozygus litterarius (Gorka) Manivit, Zeugrahabdotus embergeri (Noel) Perch-Nielsen, Calculites obscurus (Rare) (Deflandre) Prins and Sissingh in Sissingh, Helicolithus trabeculatus (Gorka) Verbeek, Thoracosphaera sp., Tranolithus gabalus Stover, Axopodorhabdus albianus (Black) Wind and Wise in Wise and Wind, Glaukolithus diplogrammus (Deflandre in Deflandre and Fert) Reinhardt, Eiffellithus turriseiffelii (Deflandre in Deflandre and Fert), Reinhardt, Retecapsa crenulata (Bramlette and Martini) Grun in Grun and Allemann, Cretarhabdus striatus (Stradner) Black, Rhagodiscus asper (Stradner) Reinhardt, Scapholithus fossilis Deflandre in Deflandre and Fert, Ellipsagelosphaera ovata (Bukry) Black, Cribosphaerella ehrenbergii (Arkhangelsky) Deflandre in Piveteau, Manivitella pematoidea (Deflandre in Manivit) Thierstein, Zeugrhabdotus elegans (Gartner), Prediscosphaera avitus (Black) Perch-Nielsen.

Comments
Age diagnostic fossils - R.achlyostaurion (martinoides Zone, Upper Aptian - lata Zone, Mid Turonian), A.albianus (lautus Zone, Mid Albian - labiatus Zone, Lower Turonian).

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Alisporites spp., Gleicheniidites senonicus (Ross) Skarby.
Dinoflagellate cysts: Achomosphaera sp. cf. A.reginensis Corradini, Aptea eisenackii (Davey) Davey and Verdier, Ascodinium scabrosum Cookson and Hughes, Batiacasphaera sp., Calliasphaeridium asymmetricum (Deflandre and Courteville) Davey and Williams, Carpodinium obliquicostatum Cookson and Hughes, Cleistosphaeridium huguoniotii (Valensi) Davey, Coronifera oceanica Cookson and Eisenack emend. May, Cribroperidinium edwardsii (Cookson and Eisenack) Davey, Cylonephelium distinctum Deflandre and Cookson, Diphaeria munda (Davey and Verdier) Norvick, Ellipsoidictyum circulatum (Clarke and Verdier) Lentin and Williams, Ellipsodinium rugulosum Clarke and Verdier, Endoceratium dettmanniae (Cookson and Hughes) Stover and Evitt, Epelidosphaeridia spinosa (Cookson and Hughes) Davey, Exochosphaeridium phragmites Davey, Downie, Sarjeant and Williams, Florentinia sp. cf. F.ferox (Deflandre) Duxbury, F.laciniata Davey and Verdier, F.radiculata (Davey and Williams) Davey and Verdier, F.stellata (Maier) Below, Hystrichodinium pulchrum Deflandre, Hystrichosphaeridium bowerbankii Davey and Williams, Leberidocysta chlamydata (Cookson and Eisenack) Stover and Evitt, Leptodinium sp., Litosphaeridium siphoniphorum (Cookson and Eisenack) Davey and Williams emend. Lucas-Clark, Microdinium crinitum Davey, M.sp. cf. M.setosum Sarjeant, Nummus monoculatus Morgan, Odontochitina costata Alberti, O.operculata (O.Wetzel) Deflandre and Cookson, Oligosphaeridium asterigerum (Gocht) Davey and Williams, O. complex (White) Davey and Williams, Palaeohystrichophora

infusorioides Deflandre, Pervosphaeridium brevispinum (Norvick) Below, P.pseudhystrichodinium (Deflandre) Yun, P.truncatum (Davey) Below, Protoellipsodinium spinosum Davey and Verdier, Pterodinium sp., Spinidinium sp., Spiniferites multibrevis (Davey and Williams) Below, S.ramosus (Ehrenberg) Loeblich and Loeblich, S.ramosus subsp. ramosus (Ehrenberg) Loeblich and Loeblich, Subtilisphaera deformans (Davey and Verdier) Stover and Evitt, S.pirnaensis (Alberti) Jain and Millepied, Trichodinium castanea (Deflandre) Clarke and Verdier.

Comments
A late Vraconian - early Cenomanian age is suggested by the following species: the first appearance of P.infusorioides, O.costata and D.munda which occur no earlier than latest Vraconian; A.verrucosum, whose range is restricted to the Vraconian - early Cenomanian; E.dettmanniae, L.siphoniphorum, E.spinosa and C.obliquicostatum, which have range bases in the Vraconian. The absence of L.arundum (range top in earliest Cenomanian) favours an early Cenomanian age. Abundant dinoflagellates which are also morphologically varied, a negligible miospore content, and scarce inertinite fragments reflect deposition in an open marine, mid-outer shelf environment.

At the top of the Glauconitic Marl is a buff-coloured, sandy chalk that is crowded with phosphatised ammonites; sample locality 12.

CB/MBH.1

FORAMINIFERA (MBH)
Arenobulimina advena (Cushman), A.anglica Cushman, Dorothia gradata (Berthelin), Marssonella trochus (d'Orbigny) Pseudotextulariella cretosa (Cushman), Tritaxia pyramidata Reuss, Bullopora laevis (Sollas), Gavelinella cenomanica (Brotzen), Gavelina intermedia (Berthelin), G.reussi (khan), Lenticulina ex. gp. gaultina (Berthelin), Tristix excavatum (Reuss), Vaginulina ex. gp. kochii Roemer, Guembilitria harrisi Tappan, Hedbergella delrioensis (Carsey), H.brittonensis Leoblich and Tappan.

Comments
A.advena and P.cretosa indicate an Early Cenomanian age.

OSTRACODA (PPEW)
Bairdoppilata pseudoseptentrionalis Mertens, *Schuleridea jonesiana (Bosquet),*Neocythere vanveeni (Mertens).

Comments
Age diagnostic fossils - Those marked with *. See ranges in Weaver (1982).

CALCAREOUS NANNOFOSSILS (JAB)
Zeugraphbdotus elegans (Gartner), Watznaueria barnesae (Black) Perch-Nielsen, Cribrophaerella ehrenbergii (Arkhangelsky) Deflandre in Piveteau, Tranolithus orionatus (Reinhardt) Reinhardt, Biscutum ellipticum (Gorka) Grun and Allemann, Discorhabdus ignotus (Gorka) Perch-Nielsen, Rhagodiscus plebeius Perch-Nielsen, Eiffellithus turriseiffelii (Deflandre in Deflandre and Fert) Reinhardt, Retecapsa angustiforata Black, Broisonia enormis (Shumenko) Manivit, Rhagodiscus achlyostaurion (Hill), Radiolithus planus Stover,

Rhagodiscus angustus (Stradner) Reinhardt, Rhagodiscus asper (Stradner) Reinhardt, Glaukolithus compactus (Bukry) Perch-Nielsen, Manivetella pemmatoidea (Deflandre in Manivit) Thiersten, Zeugrhabdotus embergeri (Noel) Perch-Nielsen, Retecapsa crenulata (Branlette and Martini) Grun in Grun and Allemann, Broisonia signata (Noel) Noel, Chiastozygus litterarius (Gorka) Manivit, Bipodorhabdus brooksii (Bukry) Crux, Haquis circumradiatus (Stover) Roth, Glaukolithus diplogrammus (Deflandre in Deflandre and Fert) Reinhardt, Rotelapillus laffitteii (Noel) Noel, Gartnerago obliquuum (Stradner) Thierstein, Ellipsagelosphaera ovata (Bukry) Black, Staurolithus crux (Deflandre and Fert) Caratini, Seribiscutum primitivum (Thierstein) Filewicz, Wind and Wise in Wise and Wind, Calculites obscurus (Rare) (Deflandre) Prins and Sissingh in Sissingh, Lithraphidites carniolensis Deflandre, Axopodorhabdus albianus (Black) Wind and Wise in Wise and Wind, Cyclasgelosphaera margereli Noel, Rhagodiscus splendens (Deflandre) Verbeek, Microstaurus chiastius (Worsley) Grun in Grun and Allemann, Braarudosphaera bigelowii (Gran and Braaud) Deflandre, Cretarhabdus striatus (Stradner) Black, Prediscosphaera avitus (Black) Perch-Nielsen.

Comments
Age diagnostic fossils - R.achlyostaurion (martinoides Zone, Upper Aptian - lata Zone, Mid Turonian), A.albianus (lautus Zone, Mid Albian - labiatus Zone, Lower Turonian), M.chiastius (regale Zone, Lower Hauterivian - gracile Zone, Upper Cenomanian), ?G.obliquum (Upper Cenomanian - Maastrichtian).

PALYNOMORPHS (DJB,JKL,AMM)
Miospores - Alisporites spp., Gleicheniidites senonicus (Ross) Skarby.
Dinoflagellate cysts: Achomosphaera ramulifera (Deflandre) Evitt, A.sp, Callaiosphaeridium asymtricum (Deflandre and Courteville) Davey and Williams, Cerbia sp., Chlamydophorella sp., Cribroperidinium exilicristatum, (Davey) Stover and Evitt, Cyclonephelium distinctum Deflandre and Cookson, Dapsilidinium warrenii (Habib) Lentin and Williams, Disphaera munda (Davey and Verdier) Norvick, Epelidosphaeridia spinosa (Cookson and Hughes) Davey, Exochosphaeridium arnace Davey and Verdier, E.sp. cf. E.phragmites Davey, Downie, Sarjeant, and Williams, E.sp. cf. E.scitulum Singh, Florentina sp. cf. F.laciniata Davey and Verdier, F.mantellii (Davey and Williams) Davey and Verdier, F.radiculata (Davey and Williams) Davey and Verdier, Hystrichodinium pulchrum Deflandre, Hystrichostrogylon membraniphorum Agelopoulos, Isabelidinium globosum (Davey) Lentin and Williams, Litosphaeridium sp., Microdinium sp., Odontchitina costata Alberti, O.operculata (O.Wetzel) Deflandre and Cookson, Oligosphaeridium asterigerum (Gocht) Davey and Williams, O.complex (White) Davey and Williams, O.prolixispinosum Davey and Williams, Palaeohystrichophora infusorioides Deflandre, Pervosphaeridium cenomaniense (Norvick) Below, Protoellipsodinium spinosum Davey and Verdier, Psaligonyaulax sp., Pterodinium sp. cf. P.aliferum Eisenack, Spiniferites ramosus (Ehrenberg) Loeblich and Loeblich, Surculosphaeridium longifurcatum (Firtion) Davey, Downie, Sarjeant and Williams, Tanyophaeridium variecalamus Davey and Williams.

Comments
The common occurrence of P.infusorioides, which has its inception in the Late Vraconian, suggests an early Cenomanian age. E.spinosa, O.costata and D.munda, which first appear in the Vraconian, are also

characteristic of Cenomanian assemblages. The relative abundance of dinoflagellate cysts and scarcity of other organic remains are consistent with an open marine environment. Prolonged exposure to oxidation where deposition took place slowly is suggested by the degraded state of the vitrinite component and the thin, flimsy, poorly-preserved aspect of some of the dinoflagellates.

Four metres above this level is a prominent marl between two sponge-rich limestones. This is sample locality 13.

CB/MBH 4

FORAMINIFERA (MBH)
Arenobulimina advena (Cushman), A.anglica Cushman, Eggerellina mariae Ten Dam, Gaudryina quadrans Cushman, Marssonella trochus (d'Orbigny), Placopsilina cenomanica d'Orbigny, Plectina mariae (Franke), Pseudotextulariella cretosa (Cushman), Spiroplectammina rectangularis Ten Dam, Textulina sp. Tritaxia pyramidata Reuss, Frondicularia cordai Reuss, Gavelinella baltica Brotzen, G.cenomanica (Brotzen), G.intermedia (Berthelin), G.reussi (khan), Palmula cordata (Reuss) Ramulina aculeata Wright, Saracenaria italica Defrance, S.vestita (Berthelin), Vaginulina ex. gp. kochii Roemer, Praeglobotruncana delrioensis (Plummer), Rotalipora appeninica (Rene), R.sp., Guembilitria harrisi Tappan, Hedbergella delnoensis (Carsey), H.brittonensis Loeblich and Tappan.

Comments
R.appeninica and P.delrioensis indicate an Early Cenomanian age. Small percentage of deeper-water planktonic morphotypes - open marine, shelf environment.

OSTRACODA (PPEW)
Pontocyprella harrisiana, (Jones), Cytherella ovata (Roemer), Bairdoppilata pseudoseptentrionalis Mertens.

Comments
Age diagnostic fossils - Those marked with*. See ranges in Weaver (1982). Poor fauna and the numbers are small due to difficulties of extraction.

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae (Black) Perch-Nielsen, Biscutum ellipticum (Gorka) Grun and Allemann, Tranolithus orionatus (Reinhardt) Reinhardt, Ellipsagelosphaera fossacincta Black, Tranolithus gabalus Stover, Eiffellithus turriseiffelii (Deflandre in Deflandre and Fert) Reinhardt, Gartnerago obliquum (Stradner) Thierstein, Broinsonia enormis (Shumenko) Manivit, Helicolithus trabeculatus (Gorka) Verbeek, Zeugrhabdotus ?noeliae Rood et al., Cribrosphaerella erhenbergii (Arkhangelsky) Deflandre in Piveteau, Prediscophaera avitus (Black) Perch-Nielsen, Glaukolithus compactus (Bukry) Perch-Nielsen, Rhagodiscus asper (Stradner) Reinhardt, Ellipsagelosphaera ovata (Bukry) Black, Retecapsa crenulata (Bramlette and Martini) Grun in Grun and Allemann, Gartnerago nanum Thierstein, Gephyrorhabdus coronadventis (Reinhardt) Hill, Manivitella pemmatoidea (Deflandre in Manivit) Thierstein, Glaukolithus diplogrammus (Deflandre in Deflandre and Fert) Reinhardt, Rotelapillus laffittei (Noel) Noel,

Zeugraphabdotus elegans (Gartner), Rhagodiscus achlyostaurion (Hill), Discorhabdus ignotus (Gorka) Perch-Nielsen, Chiastozygus litterarius (Gorka) Manivit, Seribiscutum primitivum (Thierstein) Filewicz, Wind and Wise in Wise and Wind, Scapholithus fossilis in Deflandre and Fert, Rhagodiscus angustus (Stradner) Reinhardt, Broinsonia signata (Noel) Noel, Lithraphidites carniolensis Deflandre, Eprolithus floralis (Stradner) Stover, Staurolithites crux (Deflandre and Fert) Caratini, Radiolithus planus Stover, Zeugrhabdotus embergeri (Noel) Perch-Nielsen, Microstaurus chiastius (Worsley) Grun in Grun and Allemann, Axopodorhabdus albianus (Black) Wind and Wise in Wise and Wind, Cretaphabdus conincus Bramlette and Martini, Prediscosphaera spinosa (very small) (Bramlette and Martini) Gartner, Zeugraphobdotus ponticulus (Deflandre) Reinhardt.

Comments
Age diagnostic fossils - ?G.obliquum (Upper Cenomanian - Maastrichtian), R.achlyostaurion (Upper Aptian - Mid Turonian), M.chiastius (Lower Hauterivian - Upper Cenomanian), A.albianus (Mid Albian - Lower Turonian).

PALYNOMORPHS (DJB,JKL,AMM)
Dinoflagellate cysts: Achomosphaera ramulifera (Deflandre) Evitt, A.sp. cf. A.reginensis Corradini, Apteodinium sp., Ascodinium acrophorum Cookson and Eisenack, Batiacasphaera torulosa (Davey and Verdier) Dorhofer and Davies, Cerbia sp., Chlamydophorella discreta Clarke and Verdier, C.sp., Cleistosphaeridium sp., Coronifera oceanica Cookson and Eisenack, Dinopterygium cladoides Deflandre, Ellipsoidictyum circulatum (Clarke and Verdier) Lentin and Williams, Epelidosphaeridia spinosa (Cookson and Hughes) Davey, Exochosphaeridium phragmites Davey, Downie, Sarjeant and Williams, Florentinia cooksoniae (Singh) Duxbury, F.laciniata Davey and Verdier, F.radiculata (Davey and Williams) Davey and Verdier, F.stellata (Maier) Below, Gonyaulacysta sp. cf. G.helicoidea (Eisenack and Cookson) Sarjeant, Hystrichosphaeridium bowerbankii Davey and Williams, Hystrichostrogylon membraniphorum Agelopoulos, Leptodinium sp. Litosphaeridium siphoniphorum (Cookson and Eisenack) Davey and Williams emend. Lucas-Clarke, Microdinium crinitum Davey, Nummus monoculatus Morgan, Odontochitina costata Alberti emend. Clarke and Verdie, Oligosphaeridium complex (White) Davey and Williams, Palaeohystrichophora infusorioides Deflandre, Pervophaeridium (Norvick) Below, P.cenomaniense (Norvick) Below, P.truncatum (Davey) Below, P.truncigerum (Deflandre) Yun, Psaligonyaulax deflandrei Sarjeant, Pterodinium cingulatum (O. Wetzel) Below, Spiniferites sp. cf. S.aligerus Singh, S.ramosus (Ehrenberg) Loeblich and Loeblich, S.ramosus subsp. ramosus (Ehrenberg) Loeblich and Loeblich, S.wetzelii (Deflandre) Sarjeant, Surculosphaeridium longifurcatum (Firtion) Davey, Downie, Sarjeant and Williams, Tanyosphaeridium variecalamus Davey and Williams, Trichodinium castanea (Deflandre) Clarke and Verdier.

Comments
An early Cenomanian age is indicated by the presence of E.circulatum (first appearance in the basal S.varians Zone) in conjunction with the first appearance of B.torulosa, H.bowerbankii and A.acrophorum. These occur in association with species characteristic of Cenomanian assemblages, viz. L.siphoniphorum, P.infusorioides, E.spinosa and S.longifurcatum. The absence of miospores and the small amount of mainly inertinitic detritus together with abundant and morphologically diverse

dinocysts are consistent with deposition in a mid-outer shelf environment.

One meter above this sample horizon is a prominent limestone bed that is crowded with phosphatised, broken, fossil debris. Immediately above this bed is sample locality 14.

CB/MBH 3.

FORAMINIFERA (MBH)
Ammodiscus cretaceus (Reuss), Arenobulimina advena (Cushman), A.anglica Cushman, Dorothia gradata (Berthelin), Gaudryina quadrans Cushman, Marssonella trochus (d'Orbigny), Placopsilina cenomana d'Orbigny, Plectina mariae (Franke), Pseudotextulariella cretosa (Cushman), Spiroplectammina rectangularis Ten Dam, Tritaxia pyramidata (Reuss), Frondicularia cordai Reuss, Gavelinella baltica Brotzen, G.cenomanica (Brotzen), G.intermedia (Berthelin), G.reussi (Khan), Gyroidinoides parva (khan), Quinqueloculina antiqua Franke, Ramulina aculeata Wright, Vaginulina ex. gp. kochii Roemer, Tristix excavatum (Reuss), Hedbergella delnoensis (Carsey) H.brittonensis Loeblich and Tappan, Heterohelix moremani (Cushman), Rotalipora appeninica (Renz), Praeglobotruncana delrioensis (Plummer), Guembilitria harrisi Tappan.

Comments
R.appeninica and P.delrioensis indicate an Early Cenomanian age. Small percentage of deeper-water planktonic morphotypes - open marine shelf environment.

OSTRACODA (PPEW)
Macrocypris muensteriana Jones and Hinde, Bairdoppilata pseudoseptentrionalis Mertens, Cytherella ovata (Roemer), *Schuleridea jonesiana (Bosquet), Cytherella gruendeli Weaver, Cytherella cf. C. contracta van Veen, *Neocythere vanveeni (Mertens), Monoceratina umbonata (Williamson), Cytheropteron pitsonensis Weaver, *Mandocythere harrisiana (Jones) (juvenile).

Comments
Age diagnostic fossils - Those marked with *. See ranges in Weaver (1982). Fauna limited particularly in small sized species, more species should be obtainable with care.

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae (Black) Perch-Nielsen, Tranolithus orionatus (Reinhardt) Reinhardt, Discorhabdus ignotus (Gorka) Perch-Nielsen, Biscutum ellipticum (Gorka) Grun and Allemann, Thoracosphaera sp., Eiffellithus turriseiffelii (Deflandre in Deflandre and Fert) Reinhardt, Glaukolithus compactus (Bukry) Perch-Nielsen, Ellipsagelosphaera fossacincta Black, Helicolithus trabeculatus (Gorka) Verbeek, Chiastozygus litterarius (Gorka) Manivit, Broinsonia enormis (Shumenko) Manivit, Prediscosphaera cretacea (Arkhangelsky) Gartner, Rhagodiscus asper (Stradner) Reinhardt, Staurolithites crux (Deflandre and Fert) Caratini, Microstaurus chiastius (Worsley) Grun in Grun and Allemann, Lithraphidites carniolensis Deflandre, Eprolithus floralis (Stradner) Stover, Zeugrhabdotus elegans

(Gartner), Broinsonia signata (Noel) Noel, Ellipsagelosphaera ovata (Bukry) Black, Rotelapillus laffitteii (Noel) Noel, Rhagodiscus achlyostaurion (Hill), Cribrosphaerella ehrenbergii (Arkhangelsky) Deflandre in Piveteau, Cretarhabdus striatus (Stradner) Black, Gartnerago obliquum (Stradner) Thierstein, Gartnerago nanum Thierstein, Rhagodiscus angustus (Stradner) Reinhardt, Radiolithus planus Stover, Gephyrorhabdus coronadventis (Reinhardt) Hill, Cretarhabdus conicus Bramlette and Martini, Manivitella pemmatoidea (Deflandre in Manivit) Thierstein, Rhagodiscus plebeius Perch-Nielsen, Bipodorhabdus brooksii (Bukry) Crux, Lithraphidites acutum Verbeek and Manivit in Manivit et al., Cyclagelosphaera rotaclypeata Bukry, Axopodorhabdus albianus (Black) Wind and Wise in Wise and Wind, Prediscosphaera avitus (Black) Perch-Nielsen.

Comments
Age diagnostic fossils - A.albianus (Mid Albian - Lower Turonian), M.chiastius (Lower Hauterivian - Upper Cenomanian), R.achlyostaurion (Upper Aptian - Mid Turonian).

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Alisporites spp., Deltoidospora sp., Gleicheniidites senonicus (Ross) Skarby, Lycopodiumsporites sp., Parvisaccites granisaccus Hedlund.
Dinoflagellate cysts: Achomosphaera ramulifera (Deflandre) Evitt, Ascodinium acrophorum, Cookson and Eisenack, Batiacasphaera torulosa (Davey and Verdier) Dorhofer and Davies, B.sp., Caligodinium aceras (Manum and Cookson) Lentin and Williams, Callaiosphaeridium asymmetricum (Deflandre and Courteville) Davey and Williams, Cleistosphaeridium aciculare Davey, C.huguoniotii (Valensi) Davey, C.multispinosum (Singh) Brideaux, Cometodinium whitei (Deflandre and Courteville) Stover and Evitt, Coronifera oceanica Cookson and Eisenack, Cyclonephelium distinctum Deflandre and Cookson, C.membraniphorum Cookson and Eisenack, Dapsilidinium warrenii (Habib) Lentin and Williams, Ellipsoidictyum circulatum (Clarke and Verdier) Lentin and Williams, E.rugulosum Clarke and Verdier, Epelidosphaeridia spinosa (Cookson and Hughes) Davey, Exochosphaeridium bifidum (Clarke and Verdier) Clarke, Davey, Sarjeant and Verdier, Florentinia laciniata Davey and Verdier, F.mantellii (Davey and Williams) Davey and Verdier, F.radiculata (Davey and Williams) Davey and Verdier, F.stellata (Maier) Below, Gonyaulacysta cassidata (Eisenack and Cookson) Sarjeant, Hystrichodinium pulchrum Deflandre, Hystrichosphaeridium bowerbankii Davey and Williams, Hystrichostrogylon membraniphorum Agelopoulos, Leberidocysta defloccata (Davey and Verdier) Stover and Evitt, Litosphaeridium siphoniphorum (Cookson and Eisenack) Davey and Williams emend. Lucas-Clarke, Maghrebinia perforata (Clarke and Verdier) Below, Microdinium crinitum Davey, M.irregulare Clarke and Verdier, M.sp. cf. setosum Sarjeant, Odontochitina costata Alberti, O.operculata (O. Wetzel) Deflandre and Cookson, Oligosphaeridium complex (White) Davey and Williams, O.pulcherrimum (Deflandre and Cookson) Davey and Williams, Palaeohystrichophora infusorioides Deflandre, Pervosphaeridium cenomaniense (Norvick) Below, P.pseudhystrichodinium (Deflandre) Yun, Prolixosphaeridium granulosum (Deflandre) Davey, Downie, Sarjeant and Williams, Pterodinium cingulatum (O.Wetzel) Below, P.cingulatum (O. Wetzel) Below subsp. granulatum (Clarke and Verdier) Lentin and Williams, Senoniasphaera sp., Spiniferites multibrevis (Davey and Williams) Below, S.ramosus (Ehrenberg) Loeblich and Loeblich, S.ramosus subsp. ramosus (Ehrenberg) Loeblich and Loeblich, Surculosphaeridium longifurcatum

(Firtion) Davey, Downie, Sarjeant and Williams, Tanyosphaeridium varieculamus Davey and Williams, Trichodinium castanea (Deflandre) Clarke and Verdier, Xiphodhoridium alatum (Cookson and Eisenack) Sarjeant.
Other algae: Veryhachium sp..

Comment
An early Cenomanian age is indicated by the occurrence of M.perforata (range top within S.varians Zone), M.irregulare, X.alatum and B.torulosa in association with P.deflandrei, L.siphoniphorum, P.infusorioides, E.spinosa and E.rugulosum. The occurrence of only a small amount of inertinitic kerogen and the scarcity of miospores in association with a rich and morphologically varied dinocyst assemblage reflects deposition in an open marine environment (?mid-outer shelf).

Approximately 10 meters above this level there is a marked change in lithology from limestone/marl interbeds to chalk with minor marl seams. In the beds immediately below this change in lithology there is a distinctive series of marls that contain abundant Orbirhynchia mantelliana. Above this brachiopod concentration, 1.5m below the prominent change in lithology there is a major mid-Cenomanian non-sequence (Carter and Hart 1977). This marks the base of the Rotalipora cushmani Zone and this important boundary can be traced all over southern and eastern England.

Sample locality 15 is located within the O.mantelliana horizon.

CB/MBH 6.

FORAMINIFERA (MBH)
Arenobulimina advena (Cushman) Eggerellina mariae Ten Dam, Plectina cenomana Carter and Hart, Tritaxia pyramidata Reuss, Gavelinella baltica Brotzen, G.cenomanica (Brotzen), G.reussi (Khan), Gyroidinoides parva (Khan), Lingulogavelinella turonica (Butt), Rotalipora appeninica (Renz), Hedbergella delrioensis (Carsey).

Comments
P.cenomana and R.appeninica indicate an early Middle Cenomanian age. Samples generally poorly preserved at this level.

OSTRACODA (PPEW)
Bairdoppilata pseudoseptentrionalis Mertens, Cytherella ovata (Roemer), Cytherella cf. C.contracta van Veen, Cytherelloidea stricta (Jones and Hinde), *Cythereis humilis Weaver, *Neocythere semiconcentrica (Mertens), Cytherella cf. C.truncata (Bosquet), Pontocyprella harrisiana (Jones), *Cornicythereis larivourensis (Damotte and Grosdidier), Saide cf. S.nettgauensis Grundel, Cytherella gruendeli Weaver, *Mandocythere inferangulata (Donze), Rehacythereis paranuda Weaver, *Mandocythere harrisiana (Jones), Monoceratina umbonatoides Kaye.

Comments
Age diagnostic fossils - Those marked with *. See ranges in Weaver (1982).

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae (Black) Perch-Nielsen, Tranolithus orionatus (Reinhardt) Reinhardt, Glaukolithus compactus (Bukry) Perch-Nielsen, Glaukolithus diplogrammus (Deflandre in Deflandre and Fert) Reinhardt, Gephyrorhabdus coronadventis (Reinhardt) Hill, Rhagodiscus achlyostaurion (Hill), Brionsonia enormis (Shumenko) Manivit, Zeugrhabdotus embergeri (Noel) Perch-Nielsen, Prediscosphaera avitus (Black) Perch-Nielsen, Prediscosphaera cretacea (Arkhangelsky) Gartner, Zeugrhabdotus elegans (Gartner), Eiffellithus turriseiffelii (Deflandre in Deflandre and Fert) Reinhardt, Retecapsa angustiforata Black, Manivitella pemmatoidea (Deflandre in Manivit) Thierstein, Rhagodiscus angustus (Stradner) Reinhardt, Cylindralithus serratus Bramlette and Martini, Cretarhabdus striatus (Stradner) Black, Radiolithus planus Stover, Chiastozygus litterarius (Gorka) Manivit, Discorhabdus ignotus (Gorka) Perch-Nielsen, Axopodorhabdus albianus (Black) Wind and Wise in Wise and Wind, Calculites obscurus (rare) (Deflandre) Prins and Sissingh in Sissingh), Microstaurus chiastius (Worsley) Grun in Grun and Allemann, Lithraphidites acutum Verbeek and Manivit in Manivit et al., Eprolithus floralis (Stradner) Stover, Gartnerago obliquum (Stradner) Thierstein, Lithraphidites carniolensis Deflandre, Gartnerago nanum Thierstein, Corollithion kennedyi Crux, Ellipsagelosphaera ovata (Bukry) Black, Thoracosphaera sp., Nannoconus sp., Rotelapillus laffittei (Noel) Noel, Helicolithus trabeculatus (Gorka) Verbeek, Retecapsa crenulata (Bramlette and Martini) Grun in Grun and Allemann, Rhagodiscus asper (Stradner) Reinhardt, Biscutum ellipticum (Gorka) Grun and Allemann, Zeugrhabdotus ponticulus (Deflandre) Reinhardt.

Comments
Age diagnostic fossils - R.achlyostaurion (Upper Aptian - Mid Turonian), A.albianus (Mid Albian - Lower Turonian), M.chiastius (Lower Hauterivian - Upper Cenomanian), L.acutum (Mid Cenomanian - Upper Cenomanian), C.kennedyi (Lower Cenomanian - Mid Cenomanian).

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Deloidospora sp., Foveotriletes subtriangularis Brenner Parvisaccites granisaccus Hedlund.
Dinoflagellate cysts: Achomosphaera crassipellis, A.ramulifera, Apteodinium sp., ?Ascodinium sp., Cassiculosphaeridia reticulata, Chatangiella sp., Cleistosphaeridium aciculare, C.armatum, C.huguoniotii, C.multispinosum, Cometodinium whitei, Coronifera striolata, Cribroperidinium exilicristatum, Cyclonephelium distinctum, Dapsilidinium lamina spinosum, D. sp. cf. D.pumilum, Epelidosphaeridia spinosa, Exochosphaeridium phragmites, Florentinia radiculata, F.stellata, Gonyaulacysta cassidata, Hystrichodinium pulchrum, Hystrichosphaeridium bowerbankii, Hystrichostrogylon membraniphorum, Isabelidinium sp., Kiokansium polypes, Kleithiasphaeridium readei, Leberidocysta defloccata, Leptodinium sp., Litosphaeridium siphoniphorum, Membranilarnacia polycladiata, Microdinium crinitum, M.ornatum Cookson and Eisenack, Odontochitina costata, Oligosphaeridium asterigerum, O.complex, Palaeohystrichophora infusorioides, Palaeoperidinium cretaceum, Pervosphaeridium cenomaniense, P.pseudhystrichodinium, P.truncatum, Prolixosphaeridium parvispinum, Psaligonyaulax deflandrei,

Pterodinium cingulatum, Spinidinium sp., Spiniferites multibrevis, S.ramosus, S.ramosus ramosus, S.wetzellii, Surculosphaeridium longifurcatum, Tanyosphaeridium varieculamus, Trichodinium castanea, Xenacus ceratoides (Deflandre) Lentin and Williams, Xiphodhoridium alatum.
Other algae: Cymatiosphaera radiata, Micrhystridium spp. Veryhachium spp..
Misc.: foraminiferal test linings.

Comments
A post Early - Middle Cenomanian age is suggested by the absence of Maghrebinia perforata in conjunction with the first appearance of M.ornatum and X.ceratioides (towards the top of the Schloenbachia varians Zone). These dates accord with the middle Epelidosphaeridia spinosa subzone of Clarke and Verdier's (1967) three-fold dinocyst zonation of the Cenomanian. The occurrence of large numbers of morphologically diverse dinocysts, common foraminiferal linings, a moderate amount of terrestrial detritus (vitrinite and inertinite, tracheids) and a low miospore content suggest a ?mid-outer shelf environment of deposition.

Approximately 7m above this marked change in lithology there is a massive bed of hard chalk which contains sandy, laminated lenses that often have comminuted fossil debris associated with them. Large ammonites (Acanthoceras jukes-brownei) can often be found at this level (figure 9). Sample locality 16 is located 1m below this bed.

CB/MBH.5

FORAMINIFERA (MBH)
Ammodiscus cretaceus (Reuss), Arenobulimina advena (Cushman), A.courta (Marie), A.depressa (Perner), Dorothia gradata (Berthelin), Eggerellina mariae Ten Dam, Fluorensina mariae Carter and Hart, Gaudryina quadrans Cushman, Marssonella trochus (d'Orbigny), Plectina cenomana Carter and Hart, Plectina mariae (Franke), Pseudotextulariella cretosa (Cushman), Tritaxia macfadyeni Cushman, T.pyramidata Reuss, Spiroplectinata annectens (Parker and Jones), Spiroplectammina rectanularis Ten Dam, Gavelinella baltica Brotzen, G.cenomanica (Brotzen), G.intermedia (Berthelin), Gyroidinoides parva (Khan), Lingulogavelinella turonica (Butt), Marginulina jonesi (Reuss), Palmula cordata (Reuss), Ramulina aculeata Wright, R.muricatina Loeblich and Tappan, Saracenaria jarvisi (Brotzen), Spiroloculina papyracea Burrows, Sherborn and Bailey, Vaginulina ex. gp. kochii Roemer, Guembilitria harrisi Tappan, Hedbergella delnoensis (Carsey), Heterohelix moremani (Cushman), Praeglobotruncana stephani (Plummer), Rotalipora cushmani (Morrow), R.greenhornensis (Morrow).

Comments
R.cushmani, R.greenhornensis, P.cretosa and F.mariae indicate a Late Middle Cenomanian age. Open shelf microfauna, moderate planktonic fauna.

OSTRACODA (PPEW)
Cytherella ovata (Roemer), Pterygocythereis robusta (Jones and Hinde) *Cythereis humilis humilis Weaver.

Comments
Age diagnostic fossils - Those marked with *. See ranges in Weaver (1982).

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae (Black) Perch-Nielsen, Tranolithus orionatus (Reinhardt) Reinhardt, Lithraphidites carniolensis Deflandre, Biscutum ellipticum (Gorka) Grun and Allemann, Rhagodiscus angustus (Stradner) Reinhardt, Eiffellithus turriseiffeli (Deflandre in Deflandre and Fert) Reinhardt, Glaukolithus compactus (Bukry) Perch-Nielsen, Retecapsa angustiforata, Ellipsagelosphaera fossacincta, Axopodorhabdus albianus (Black) Wind and Wise in Wise and Wind, Retecapsa crenulata (Bramlette and Martini) Grun in Grun and Allemann, Eprolithus floralis (Stradner) Stover, Prediscosphaera cretacea (Arkhangelsky) Gartner, Staurolithites crux (Deflandre and Fert) Caratini, Helicolithus trabeculatus (Gorka) Verbeek, Rhagodiscus achlyostaurion (Hill), Brionsonia enormis (Shumenko) Manivit, Zeugrhabdotus ?noeliae Rood et al., Zeugrhabdotus elegans (Gartner), Broinsonia signata (Noel) Noel, Chiastozygus litterarius (Gorka) Manivit, Prediscosphaera avitus (Black) Perch-Nielsen, Discorhabdus ignotus (Gorka) Perch-Nielsen, Cylindralithus serratus Bramlette and Martini, Cyclagelosphaera margereli Noel, Rhagodiscus asper (Stradner) Reinhardt, Cretarhabdus striatus (Stradner) Black, Cribrosphaerella ehrenbergii (Arkhangelsky) Deflandre in Piveteau, ?Lithraphidites acutum (rare) Verbeek and Manivit in Manivit et al., Zeugrhabdotus embergeri (Noel) Perch-Nielsen, Microstaurus chiastius (Worsley) Grun in Grun and Allemann, Ellipsagelosphaera ovata (Bukry) Black, Corollithion kennedyi Crux, Manivitella pemmatoidea (Deflandre in Manivit) Thierstein, Prediscosphaera spinosa (very small) (Bramlette and Martini) Gartner, Thoracosphaera sp., Nannoconus sp., Rotelapillus laffittei (Noel) Noel, Zeugrhabdotus ponticulus (Deflandre) Reinhardt.

Comments
Age diagnostic fossils - A.albianus (Mid Albian - Lower Turonian), R.achlyostaurion (Upper Aptian - Mid Turonian), ?L.acutum (Mid Cenomanian - Upper Cenomanian), M.chiastius (Lower Hauterivian - Upper Cenomanian), C.kennedyi (Lower Cenomanian - Mid Cenomanian).

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Alisporites sp., Camarozonosporites sp., Cicatricosisporites sp., Gleicheniidites senonicus, Leptolepidites sp.
Dinoflagellate cysts: Achomosphaera crassipellis, A.ramulifera, Apteodinium sp., Callaiosphaeridium asymmetricum, Cassiculosphaeridia reticulata, Chlamydophorella sp., Cleistosphaeridium aciculare, C.armatum, C.?flexuosum, C.huguoniotii, C.multifurcatum, Coronifera striolata, Cribroperidinium exilicristatum, Cyclonephelium distinctum, C.hystrix, Ellipsoidictyum circulatum, E.imperfectum, Endoscrinium campanula, Epelidosphaeridia spinosa, Exochosphaeridium arnace, E.bifidum, E.phragmites, Florentinia laciniata, F.stellata, Gonyaulacysta cassidata, Hystrichodinium pulchrum, Hystrichosphaeridium bowerbankii, Hystrichostrogylon membraniphorum, Isabelidinium sp., Kalyptea sp., Kickansium

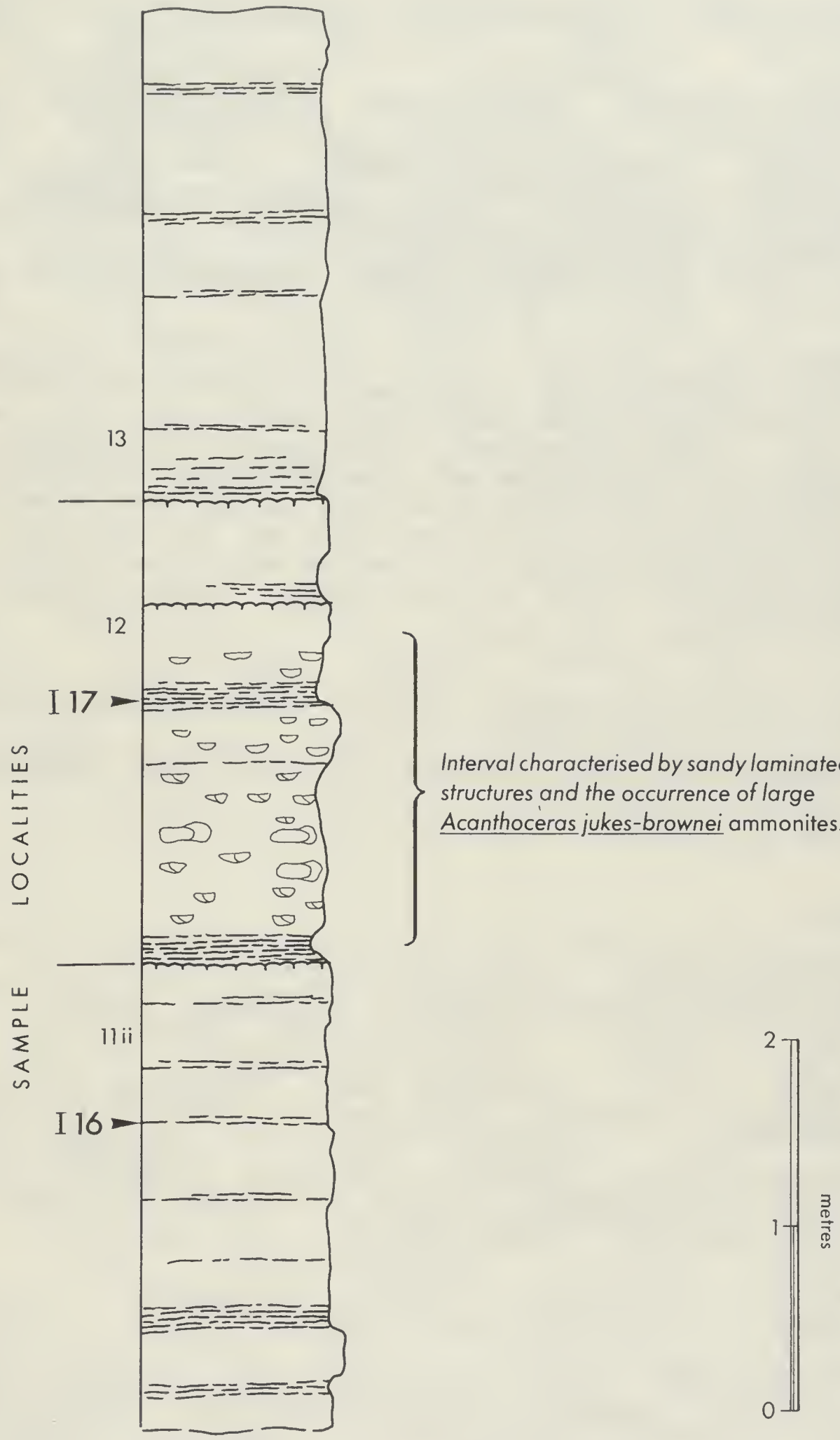


Figure 9. Compton Bay (Sample Localities 16-17). About 200 m west of the prominent change in lithology shown in Figure 8 a distinctive series of beds of chalk come down to beach level. These hard chalks contain small lens of sandy, laminated chalk. The Middle/Upper Cenomanian boundary is probably located at the Zone 12/13 (Carter and Hart, 1977) boundary.

polypes, Leberidocysta chlamydata, D.defloccata, Leptodinium sp., Litosphaeridium siphoniphorum, Membranilarnacia polycladiata, Microdinium crinitum, M.irregulare, M.ornatum, Odontochitina costata, O.operculata, Oligosphaeridium complex, Palaeohystrichophora infusorioides, Pervosphaeridium brevispinum, P.cenomaniense, P.truncatum, Prolixosphaeridium capitatum, Pterodinium cingulatum, P.cingulatum granulatum, Spiniferites crassimuratus, S.multibrevis, S.ramosus, S.ramosus ramosus, Stephodinium ceronatum, Surculosphaeridium longifurcatum, Xenacus ceratoides, Xiphodhoridium alatum.
Other algae: Cymatiosphaera radiata, Micrhystridium sp. Veryhachium sp.

Comments
A middle Cenomanian age (equivalent to Clarke and Verdier's (1967) Epelidosphaeridia spinosa Zone) is indicated by the presence of M.ornatum, X.ceratioides and S.crassimuratus in association with E.spinosa, L.siphoniphorum and other previously mentioned Cenomanian species. A transgressive high-stand may be indicated by the increase in dinocyst species diversity at this horizon and the absence of benthonic foraminiferal test-linings. The negligible miospore content and small amount of inertinitic detritus present lends support to this interpretation.

Within this bed of harder, laminated chalk, there is a soft marl that yields a fauna and flora typical of the basal Upper Cenomanian; sample locality 17

CB/MBH.7

FORAMINIFERA (MBH)
Arenobulimina advena (Cushman), Dorothia gradata (Berthelin), Marssonella trochus (d'Orbigny), Plectina cenomana Carter and Hart, P.mariae (Franke), Textularia chapmani Lalicker, Tritaxia macfadyeni Cushman, T.pyramidata Reuss, Gavelinella baltica Brotzen, G.cenomanica (Brotzen), G.intermedia (Berthelin), Gyroidinoides parva (khan), Lenticulina ex. gp. gaultina (Berthelin), Lingulogavelinella turonica (Butt), Hedbergella delrioensis (Carsey), H.brittonensis Loeblich and Tappan, Heterohelix moremani (Cushman), Rotalipora cushmani (Morrow).

Comments
R.cushmani indicates an early Late Cenomanian age.

OSTRACODA (PPEW)
Bairdoppilata pseudoseptentrionalis Mertens, Cytherella gruendeli Weaver, Cytherella ovata (Roemer), C. cf. C. truncata (Bosquet), C.spp., Cytherelloidea sp., Pontocyprella harrisiana (Jones), Paracypris aff. P. wrothamensis Kaye, Xestoleberis planus Weaver, *Loxoconcha? bluebellensis, *Mandocythere harrisiana (Jones) (juveniles), *Oertliella donzei Weaver, *Idiocythere donzei Weaver, Pseudobythocythere colini Weaver.

Comments
Age diagnostic fossils - Those marked with *. See ranges in Weaver (1982).

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae (Black) Perch-Nielsen, Biscutum ellipticum (Gorka) Grun and Allemann, Eprolithus floralis (Stradner) Stover, Radiolithus planus Stover, Prediscosphaera cretacea (Arkhangelsky) Gartner, Prediscosphaera avitus (Black) Perch-Nielsen, Chiastozygus litterarius (Gorka) Manivit, Tranolithus orionatus (Reinhardt) Reinhardt, Eiffellithus turriseiffelii (Deflandre in Deflandre and Fert) Reinhardt, Retecapsa angustiforata Black, Helicolithus trabeculatus (Gorka) Verbeek, Rhagodiscus spendens (Deflandre) Verbeek, Cyclagelosphaera margereli Noel, Broinsonia signata (Noel) Noel, Rhagodiscus achlyostaurion (Hill), Braarudosphaera bigelowii (Gran and Braarud) Deflandre, Cretarhabdus striatus (Stradner) Black, Lithraphidites carniolensis Deflandre, Rhagodiscus angustus (Stradner) Reinhardt, Axopodorhabdus albianus (Black) Wind and Wise in Wise and Wind, Discorhabdus ignotus (Gorka) Perch-Nielsen, Prediscosphaera spinosa (very small) (Bramlette and Martini) Gartner, Microstaurus chiastius (Worsley) Grun in Grun and Allemann, Retecapsa crenulata (Bramlette and Martini) Grun in Grun and Allemann, Radiolithus planus Stover, Ellipsagelosphaera ovata (Bukry) Black, Cribrosphaerella ehrenbergii (Arkhangelsky) Deflandre, Glaukolithus compactus (Bukry) Perch-Nielsen, Cylindralithus serratus Bramlette and Martini, Prediscosphaera avitus (Black) Perch-Nielsen, Lithraphidites acutum Verbeek and Manivit in Manivit et al., Corollithion signum Stradner, Broinsonia enormis (Shumenko) Manivit, Ellipsagelosphaera fossacincta Black, Rhagodiscus asper (Stradner) Reinhardt, Manivitella pemmatoidea (Deflandre in Manivit) Thierstein, Glaukolithus diplogrammus (Deflandre in Deflandre and Fert) Reinhardt, Zeugrhabdotus elegans (Gartner).

Comments
Age diagnostic fossils - R.achlyostaurion (Upper Aptian - Mid Turonian), A.albianus (Mid Albian - Lower Turonian), M.chiastius (Lower Hauterivian - Upper Cenomanian), L.acutum (Mid Cenomanian - Upper Cenomanian).

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Alisporites spp., Cicatricosisporites sp., Deltoidospora sp., Lycopodiumsporites sp.
Dinoflagellate cysts: Achomosphaera crassipellis, A.ramulifera, Apteodinium sp., Ascodinium sp. cf. A.acrophorum, Caligodinium aceras, Callaiosphaeridium asymmetricum, Cassiculosphaeridia reticulata, C.sp., Cleistosphaeridium aciculare, C.armatum, C.huguoniotii, Cometodinium whitei, Coronifera striolata, Cribroperidinium exilicristatum, Cyclonephelium distinctum, C.paucispinum, Dapsilidinium warrenii, Ellipsoidictyum imperfectum, Endoscrinium campanula, Epelidosphaeridia spinosa, Exochosphaeridium arnace, E.bifidum, Florentinia ferox, F.laciniata, F.stellata, Gonyaulacysta cassidata, Hystrichodinium pulchrum, Hystrichosphaeridium bowerbankii, Hystrichostrogylon membraniphorum, Kiokansium polypes, Leberidocysta chlamydata, L.defloccata, Leptodinium sp., Litosphaeridium siphoniphorum, Membranilarnacia polycladiata, Microdinium crinitum, M.ornatum, Odontochitina costata, Oligosphaeridium complex, Palaeohystrichophora infusorioides, Pervosphaeridium cenomaniense, P.pseudhystrichodinium, P.truncatum, Prolixosphaeridium parvispinum, Psaligonyaulax

deflandrei, Pterodinium cingulatum, Spiniferites compactus, S.crassimuratus, S.multibrevis, S.ramosus, S.ramosus ramosus, Surculosphaeridium longifurcatum, Trichodinium castanea, Wallodinium anglicum, Xenacus ceratoides, Xiphodhoridium alatum.
Other algae: Eyrea nebulosa Cookson and Eisenack, Pterophermella sp.

Comments
A Middle Cenomanian age is indicated, as for the preceding sample, by the presence of X.ceratioides, M.ornatum and S.crassimuratus in association with E.spinosa. A rich, diverse dinocyst assemblage characterized by "blooms" of a number of species, may indicate increased water depth. Impoverished terrestrial content and the absence of acanthomorph acritarchs and foraminiferal test-linings lend support to these conclusions.

Beyond this point the 'plenus Marls' and the base of the Turonian chalks eventually come down to beach level but access beyond that point is dangerous and on no account should an attempt be made to continue west to Freshwater Bay.

Culver Cliff (SZ628 854), sample localities 18-28 (Figures 10-13)

This section, from Yaverland Car Park towards Culver Cliff (Fig.10) follows a succession (Fig.11) from the Wessex Formation through to the Middle Chalk. A large part of the succession is badly exposed, except the Ferruginous Sands that form the prominent Red Cliff. The Gault Cliff is again badly slipped but the lowest part can be sampled immediately above the Carstone; sample locality 18.

CC/MBH 8.

FORAMINIFERA (MBH)
Ammobaculites subcretacea Cushman and Alexander, Arenobulimina chapmani Cushman, Dorothia gradata (Berthelin), Eggerellina mariae Ten Dam, Tritaxia singularis Magniez-Jannin, Frondicularia cordai Reuss, Gavelina intermedia (Berthelin) Gavelinella reussi (Khan), Globulina lacrima Reuss, Lenticulina ex. gp. gaultina (Berthelin), Lingulogavelinella albiensis Malapris, Marginulina bronni (Roemer), M.jonesi (Reuss), Nodosaria obscura Reuss, N.sceptrum Reuss, Vaginulina ex. gp. kochii Roemer.

Comments:
A.chapmani indicates a late Albian age. Shallow-water marine fauna.

OSTRACODA (PPEW)
No ostracods recovered.

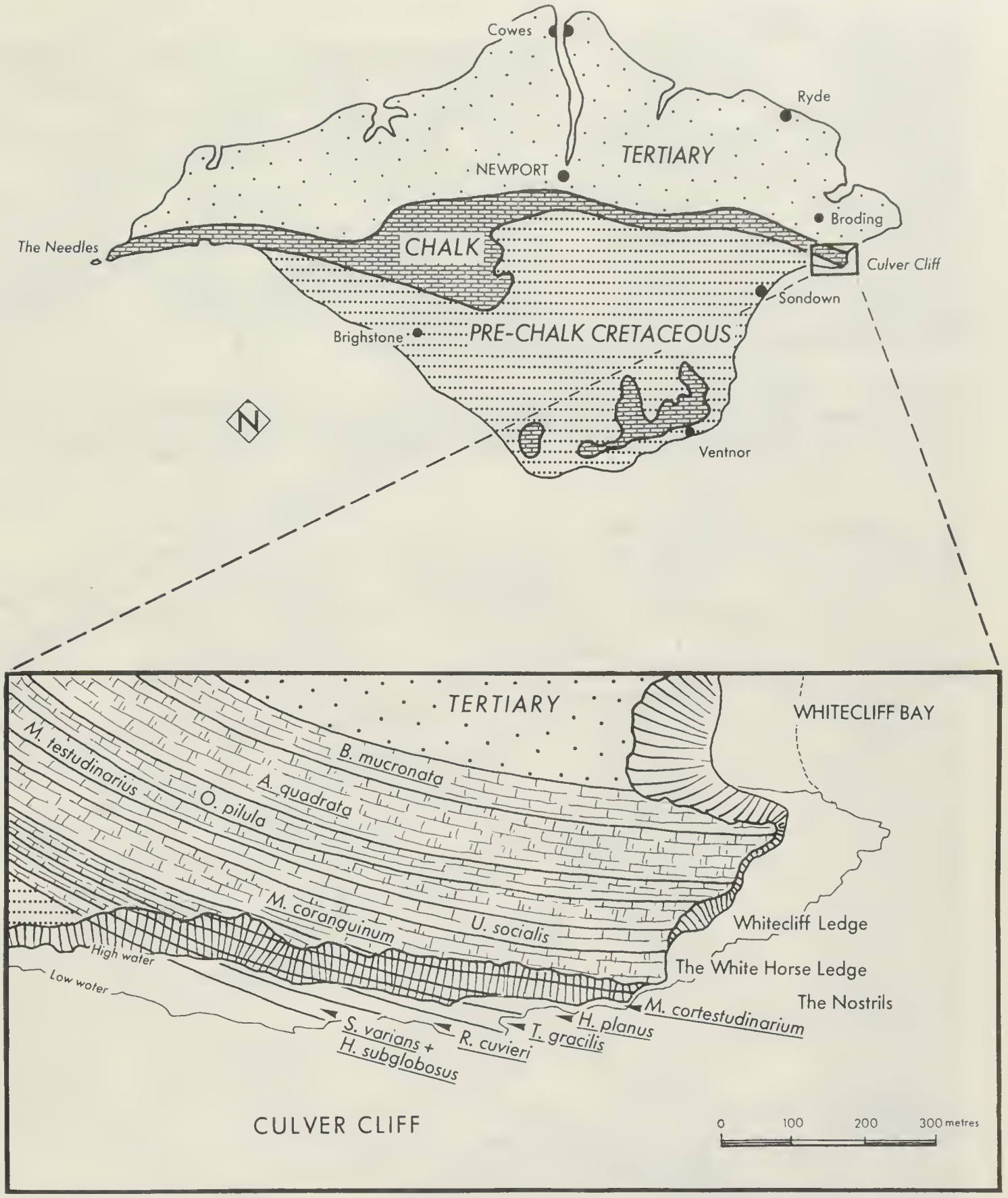


Figure 10. The Culver Cliff succession of the Chalk Group at the eastern end of the Isle of Wight. Access through to the H. planus Zone is from the Sandown end of the section, while access down to the M. cortestudinarium Zone is from the Whitecliff Bay end of the section. It is impossible to round the headland by The Nostrils on foot.

CALCAREOUS NANNOFOSSILS (JAB)

Watznaueria barnesae, Ellipsagelosphaera ovata, Rhagodiscus angustus, Eprolithus floralis, Rhagodiscus achlyostaurion, Zeugrhabdotus erectus, Lithraphidites carniolensis, Biscutum ellipticum, Staurolithites crux, Radiolithus planus, Prediscosphaera avitus, Cribrosphaerella ehrenbergii, Micrantholithus sp., Glaukolithus compactus, Bukrylithus ambiguus, Prediscosphaera cretacea, Chiastozygus litterarius, Eiffellithus turriseiffelii (rare and only spine seen), Rotelapillus laffittei, Retecapsa crenulata, Cretarhabdus striatus, Rhagodiscus asper, Axopodorhabdus albianus, Stoverius biarcus, Seribiscutum primitivum, Prediscosphaera spinosa, Loxolithus armilla.

Comments

Age diagnostic fossils - R.achlyostaurion (Upper Aptian - Mid Turonian), A.albianus (Mid Albian - Lower Turonian), ?E.turriseiffelii (Upper Albian - Maastrichtian).

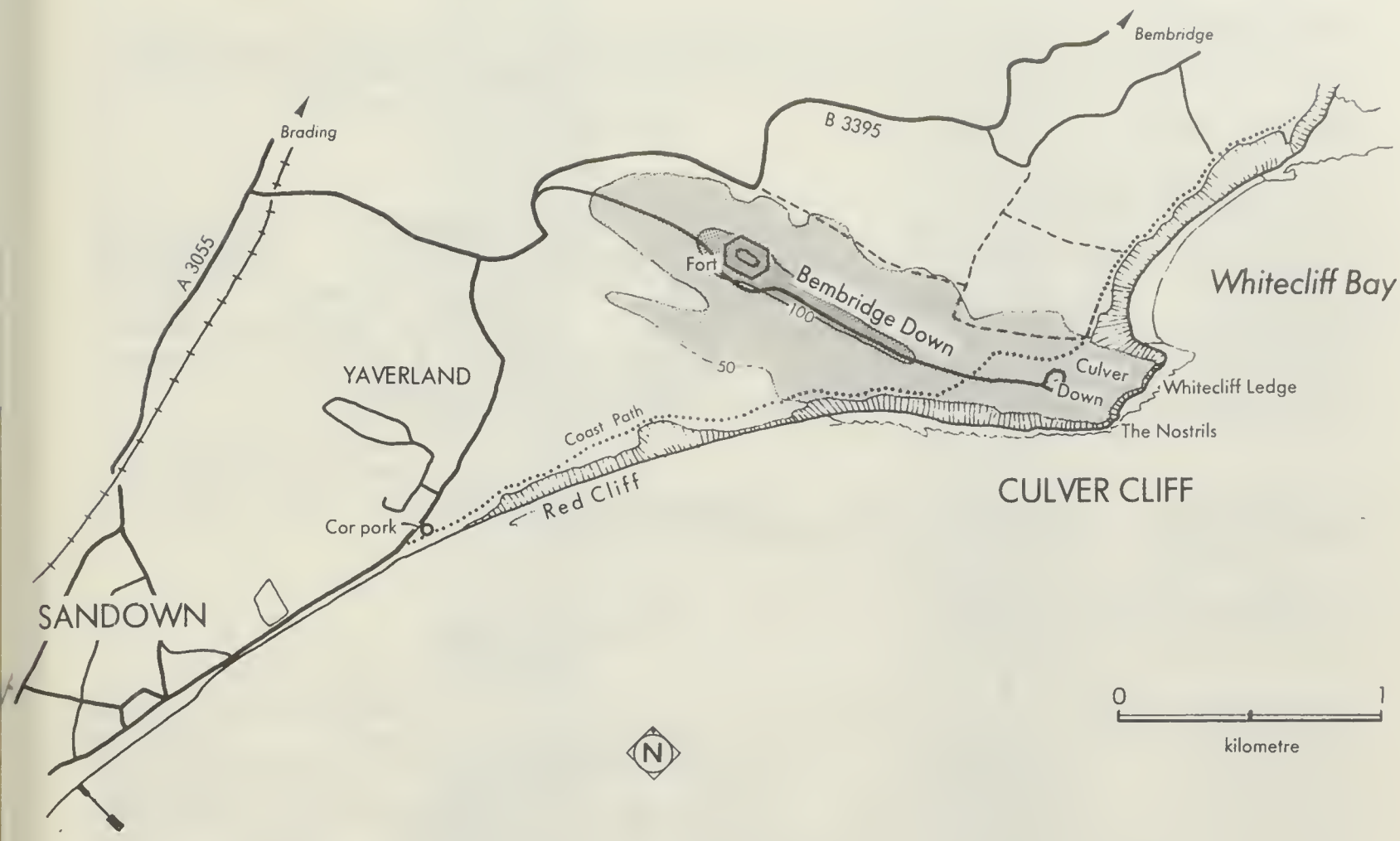
PALYNOMORPHS (DJB,JKL,AMM)

Miospores: Alisporites spp, Lycopodiumsporites marginatus Singh.
Dinoflagellate cysts: Achomosphaera crassipellis, A.ramulifera, Ascodinium scabrosum, Batiacasphaera torulosa, Chlamydophorella sp., Cleistosphaeridium huguoniotii, C.multispinosum, Cometodinium whitei, Coronifera oceanica, Cribroperidinium edwardsii, Cyclonephelium membraniphorum, Dapsilidinium sp. cf. D.pumilum, Disphaera munda, Dissiliodinium globulum, Endoscrinium campanula, Epelidosphaeridia spinosa, Exochosphaeridium sp. cf. E.phragmites, Florentinia mantellii, F.radiculata, F.stellata, Fromea complicata, Gonyaulacysta cassidata, Hystrichodinium pulchrum, H.voigtii, Hystrichosphaeridium bowerbankii, Hystrichostrogylon membraniphorum, Kiokansium polypes, Kleithiasphaeridium sp. cf. K.readei, Leberidocysta defloccata, Leptodinium sp., Litosphaeridium arundum, Maghrebinia perforata, Microdinium setosum, Occisucysta sousensis, Odontochitina operculata, Oligosphaeridium asterigerum, O.complex, O.pulcherrimum, Palaeoperidinium cretaceum, Pervosphaeridium brevispinum, P.pseudhystrichodinium, Protoellipsodinium spinocristatum, P.spinosum, Pterodinium cingulatum, P.cingulatum granulatum, Spiniferites multibrevis, S.ramosus, S.ramosus ramosus, S.wetzellii, Stephodinium coronatum, Stiphrosphaeridium anthophorum, Surculosphaeridium longifurcatum, Tanyosphaeridium varieculamus.
Other algae: Eyrea nebulosa, Micrystridium sp.,
Misc.: foraminiferal linings.

Comments

A late Albian-Vraconian age is suggested by the following species: A.scabrosum, E.spinosa, M.perforata, D.munda, H.bowerbankii, B.torulosa and C.membraniphorum. The presence of P.spinocristatum precludes an age younger than late Vraconian. The depositional environment is interpreted as mid-outer shelf on the basis of an impoverished terrestrial content in conjunction with abundant dinoflagellates of high species diversity and common foraminiferal test-linings.

The Upper Greensand is rarely exposed and samples can only be obtained from the intensely bioturbated glauconitic sandstones that are seen



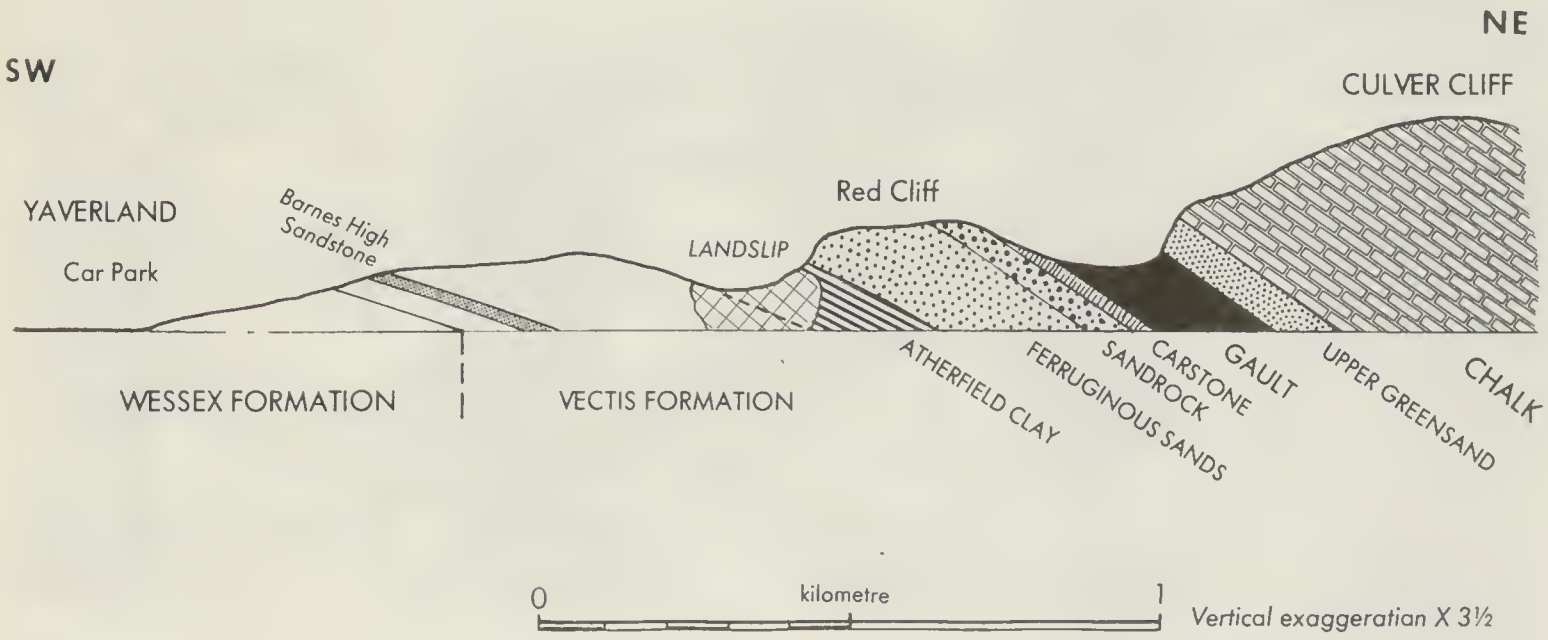


Figure 11. Culver Cliff (Sample Localities 18-28). The southern part of the Culver Cliff succession is approached from Yaverland. The cliffs along this section are badly slumped and several of the lithologies are better sampled on the western coast of the island. Section modified from Daley and Insole (1984) and shows the major feature of Red Cliff. The details of the sample points are shown on Figure 12.

immediately below the overlying Glauconitic Marl (Figure 12); sample locality 19.

Sample CC/MBH 1

FORAMINIFERA (MBH)
Arenobulimina advena, A. sp. cf. A. truncata, Fluorensina intermedia Ten Dam, Intaxia pyramidata Reuss, Gavelinella cenomanica, G.intermedia, G.reussi, Gyroidinoides parva, Lenticulina rotulata, Marginulina jonesi, Nodosaria sceptrum Reuss, Globigerinelloides bentonensis, Guembilitria harrisi Tappan, Hedbergella delrioensis, H.planispira, Heterohelix moremani.

Comments
F.intermedia, A.advena, and G.bentonensis indicate an earliest Cenomanian age. Shallow-water marine environment.

OSTRACODA (PPEW)
No ostracods recovered.

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae, Ellipsagelosphaera ovata, Biscutum ellipticum, Staurolithites crux, Rhagodiscus achlyostaurion, Eiffellithus turriseiffelii, Lithraphidites carniolensis, Retecapsa crenulata, Seribiscutum primitivum, Prediscosphaera avitus (very small), Zeugrhabdotus erectus, Prediscosphaera cretacea.

Comments
Age diagnostic fossils - R.achlyostaurion (Upper Aptian - Mid Turonian), E.turriseiffelii (Upper Albian - Maastrichtian).

PALYNOMORPHS (DJB,JKL,AAM)
Miospores: Alisporites spp., Cyathidites sp.
Dinoflagellate cysts: Achomosphaera crassipellis, A.ramulifera, A. sp. cf. A.reginensis, Ascodinium scabrosum, Cleistosphaeridium aciculare, C.armatum, C.huguoniotii, Coronifera oceanica, Cribroperidinium exilicristatum, Cyclonephelium compactum, C.distinctum, Epelidosphaeridia spinosa, Exochosphaeridium phragmites, Florentinia mantellii, F.stellata, Hystrichostrogylon membraniphorum, Kleithiasphaeridium sp. cf. K.readei, Litosphaeridium arundum, Microdinium crinitum, Odontochitina costata, O.operculata, Oligosphaeridium asterigerum, O.complex, Pervosphaeridium brevispinum, P.cenomaniense, P.truncatum, P.sp., Protoellipsodinium spinosum, Spiniferites multibrevis, S.ramosus, S.ramosus ramosus, Stephodinium coronatum, Stiphrosphaeridium anthophorum, Surculosphaeridium longifurcatum, Trichodinium castanea.
Other algae: Veryhachium sp.

Comments
A Vraconian age is suggested by the presence of A.scabrosum, L.arundum, K.sp. cf. K.readei, O.costata and E.spinosa. The occurrence of P.spinosum precludes an age younger than Vraconian. A limited phytoclast content almost entirely composed of inertinite, the presence of very few miospores, and a dinocyst assemblage of only moderate diversity with simple thin-spined chorate forms the dominant morphotype

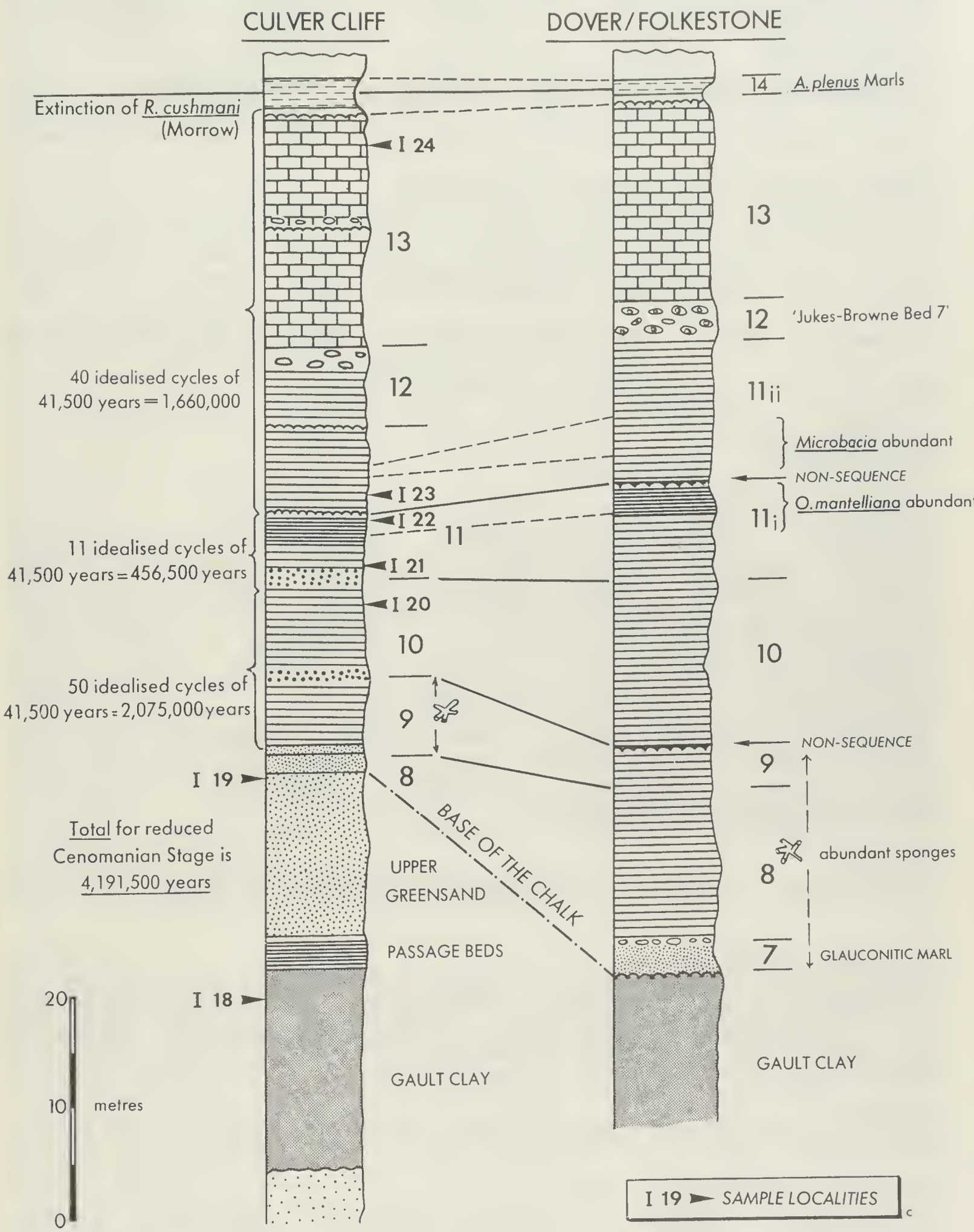


Figure 12. Culver Cliff (Sample Localities 18-28). The sample points suggested on this section complement those taken from Compton Bay. Folkestone succession (Carter and Hart 1977) is given for comparison. Recent work on the possible orbital forcing of the rhythmic sedimentation has shown that it is possible to identify 41,500 year cycles in this succession and then attempt an estimate for the duration of the Cenomanian stage. Harland et al. (1982) quote 6.5 million years for the stage while Hallam et al. suggest - using American data - only some 5 million years. When one considers the reduced nature of the succession at Culver Cliff, and the accuracy of the initial radiometric data, both these figures can be accommodated with little difficulty. The cycle prediction gives a duration for the reduced Stage seen at this locality of 4,91,500 years.

suggest that deposition occurred in a well-oxygenated, relatively shallow marine environment.

Above the base of the Glauconitic Marl the Cenomanian succession is quite clearly exposed at the time of writing (Autumn 1986) and the following sample localities can be easily recognised.

Within the limestone/marl rhythms of the upper part of the Lower Cenomanian, below a distinctive change in lithology, is sample locality 20.

Sample CC/MBH 7

FORAMINIFERA (MBH)
Ammodiscus cretaceus, Arenobulimina anglica Cushman, A.advena, A.courta, Dorothia gradata, Eggerellina mariae Ten Dam, Marssonella trocus, Plectina mariae Pseudotextulariella cretosa, Textularia sp., Tritaxia macfadyeni Cushman, T.pyramidata Reuss, Frondicularia archiaciana d'Orbigny, F.cordai Reuss, Gavelinella baltica Brotzen, G.cenomanica, G.intermedia, G.reussi, Globulina prisca Reuss, Gyroidinoides parva, Lenticulina ex. gp. rotulata, Lingulogavelinella turonica, Palmula cordata, Praebulimina spp., Ramulina muricatina Loeblich and Tappan, Spiroculina papyracea Burrows, Sherborn and Bailey, Saracenaria jarvisi, Vaginulina ex. gp. kochii Roemer, Hedbergella delrioensis, H.planispira, Heterohelix moremani, Rotalipora appeninica.

Comments
R.appeninica, A.anglica and P.cretosa indicate an Early Cenomanian age.

OSTRACODA (PPEW)
Pontocyprella harrisiana, Cytherella ovata, Bairdoppilata pseudoseptentrionalis Mertens, Cytherelloidea stricta, Cytherella sp., *Neocythere semiconcentrica, Monoceratina umbonata, Cytherella gruendeli Weaver, Cytherella cf. C. contracta van Veen.

Comments
Age diagnostic fossils - Those marked with *. See ranges in Weaver (1982).

CALCAREOUS NANNOFOSSILS (JAB)
Zeugrhabdotus erectus, Watznaueria barnesae, Broinsonia enormis, Rhagodiscus angustus, Prediscosphaera cretacea, Glaukolithus compactus, Tranolithus orionatus, Rhagodiscus achlyostaurion, Braarudosphaera bigelowi, Microstaurus chiastius, Biscutum ellipticum, Manivitella pemmatoidea, Eiffellithus turriseiffelii, Discorhabdus ignotus, Zeugrhabdotus embergeri, Lithraphidites carniolensis, Rotelapillus laffittei, Stoverius achylosus, Retecapsa crenulata, Scapholithus fossilis, Lithraphidites acutum, Broinsonia signata, Cyclagelosphaera margereli, Ellipagelosphaera

ovata, Gephyrorhabdus coronadventis, Radiolithus planus, Axopodorhabdus albianus, Bipodorhabdus brooksii, Helicolithus trabeculatus, Gartnerago nanum, Retecapsa angustiforata, Braarudosphaera regularis, Corollithion kennedyi, Staurolithites crux, Zeugrhabdotus elegans, Chiastozygus litterarius, Scapholithus fossilis, Rhagodiscus asper, Cylindralithus serratus, Eprolithus floralis.

Comments:
Age diagnostic fossils - R.achlyostaurion (Upper Aptian - Mid Turonian), M.chiastius (Lower Hauterivian - Upper Cenomanian), L.acutum (Mid Cenomanian - Upper Cenomanian), A.albianus (Mid Albian - Lower Turonian), C.kennedyi (Lower Cenomanian - Mid Cenomanian).

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Vadaszisporites sacali Deak and Combaz.
Dinoflagellate cysts: Achomosphaera crassipellis, A.ramulifera, Callaiosphaeridium asymmetricum, Cassiculosphaeridia reticulata, Cleistosphaeridium armatum, C.huguoniotii, Coronifera oceanica, C.striolata, Cribroperidinium intracatum, Cyclonephelium distinctum, Dapsilidinium sp. cf. D.lamina spinosum, Endoscrinium campanula, Epelidosphaeridia spinosa, Exochosphaeridium arnace, E.phragmites, Florentinia ferox, F.mantellii, F.stellata, Gonyaulacysta cassidata, Hystrichodinium pulchrum, Hystrichosphaeridium bowerbankii, H.recurvatum, Hystrichostrogylon membraniphorum, Kiokansium polypes, Kleithiasphaeridium readei, Leberidocysta chlamydata, L.defloccata, Litosphaeridium siphoniphorum, Maghrebinia perforata, Microdinium ornatum, Odontochitina costata, Oligosphaeridium complex, Palaeohystrichophora infusorioides, Pervosphaeridium brevispinum, P.cenomaniense, P.pseudhystrichodinium, P.truncatum, Pterodinium cingulatum, Spiniferites crassimuratus, S.membranaceus, S.multibrevis, S.ramosus, S.ramosus ramosus, S.wetzellii, Stephodinium coronatum, Surculosphaeridium longifurcatum, Tanyosphaeridium boletum, T.varieculamus, Trichodinium castanea, Wallodinium luna, Xiphodhoridium alatum.
Other Algae: Michrhystridium sp., Veryhachium sp.
Misc.: foraminiferal test-linings.

Comments
A Late Early-Middle Cenomanian age (equivalent to Clarke and Verdier's (1967) Epelidosphaeridia spinosa subzone) is suggested by the presence of M.ornatum and S.crassimuratus in association with E.spinosa and L.siphoniphorum. An inner to mid-shelf environment is suggested by abundant, morphologically diverse dinocysts in association with common foraminiferal test-linings. Some terrestrial influence on the site of deposition is indicated by the presence of a moderate amount of coarse, structured tracheidal debris, rare cuticles and traces of amorphous organic matter.

At the boundary between the Lower and Middle Cenomanian there is a distinctive limestone that contains phosphatised ammonites. Immediately above this is sample locality 21.

Sample CC/MBH 11.

FORAMINIFERA (MBH)
Arenobulimina advena, A.courta, A.depressa, Dorothia gradata, Eggerellina mariae, Gaudryina austinana Cushman, Marssonella trochus, Plectina cenomana Carter and Hart, P.mariae, Pseudotextulariella cretosa, Spiroplectammina rectangularis Ten Dam, Textularia chapmani Lalicker, Tritaxia pyramidata Reuss, Dentalina bambusa, D.distincta Reuss, Edithaella sessilis Fuchs, Frondicularia cordai Reuss, Gavelinella baltica Brotzen, G.cenomanica, G.intermedia, G.reussi, Globulina prisca Reuss, Gyroidinoides parva, Lenticulina ex. gp. rotulata, Lingulogavelinella turonica, Marginulina jonesi, Palmula cordata, Pleurostomella sp., Quinqueloculina antiqua Franke, Ramulina aculeata Wright, R.muricatina Loeblich and Tappan, Saracenaria jarvisi, Spiroloculina papyracea Burrows, Sherbor and Bailey, Vaginulina ex. gp. kochii Roemer, Guembilitria harrisi Tappan, Hedbergella delnoensis, H.planispira, Heterohelix moremani.

Comments
A.advena, P.cenomana and P.certosa indicate an early Middle Cenomanian age.

OSTRACODA (PPEW)
Bairdoppilata pseudoseptentrionalis Mertens, Cytherella ovata, *Pontocyprella robusta Weaver, Cytherella concava Weaver.

Comments
Age diagnostic fossils - Those marked with *. See ranges in Weaver (1982). Poor fauna. Numbers restricted due to difficulties of extraction.

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae, Zeugrhabdotus erectus, Eiffellithus turriseiffellii, Tranolithus orionatus, Manivitella pemmatoidea, Rhagodiscus achlyostaurion, Prediscosphaera cretacea, Prediscosphaera avitus, Cribrosphaerella ehrenbergii, Bipodorhabdus brooksii, Discorhabdus ignotus, Chiastozygus litterarius, Eprolithus floralis, Biscutum ellipticum, Zeugrhabdotus embergeri, Broinsonia enormis, Axopodorhabdus albianus, Helicolithus trabeculatus, Rhagodiscus asper, Cretarhabdus striatus, Prediscosphaera spinosa (small), Retecapsa crenulata, Radiolithus planus, Rhagodiscus angustus, Glaukolithus compactus, Rotelapillus laffittei, Ellipsagelosphaera fossacincta, Cylindralithus serratus, Ellipsagelosphaera ovata, Nannoconus regularis, Lithraphidites carniolensis, Zeugrhabdotus ponticulus.

Comments
Age diagnostic fossils - R.achlyostaurion (Upper Aptian - Mid Turonian), A.albianus (Mid Albian - Lower Turonian), E.turriseiffelii (Upper Albian - Maastrichtian).

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Alisporites sp., Cyathidites minor Couper, Laevigatosphorites ovatus Wilson and Webster, Parvisaccites granisaccus Hedlund.
Dinoflagellate cysts: Achomosphaera crassipellis, A.ramulifera, A.sp. cf. A.reginensis, Carpodinium obliquicostatum, Cleistosphaeridium aciculare, C.huguoniotii, Coronifera oceanica, C.striolata, Cribroperidinium

exilicristatum, Cyclonephelium distinctum, Dapsilidinium warrenii, Ellipsodinium rugulosum, Ellipsoidictyum circulatum, E.imperfectum, Endoscrinium campanula, Epelidosphaeridia spinosa, Exochosphaeridium arnace, E.bifidum, E.phragmites, Florentinia ferox, F.laciniata, F.stellata, Hystrichodinium pulchrum, Hystrichosphaeridium bowerbankii, Hystrichostrogylon membraniphorum, Kiokansium polypes, Leberidocysta chlamydata, L.defloccata, Litosphaeridium siphoniphorum, Membranilarnacia polycladiata, Microdinium crinitum, M.irregulare, M.setosum, Nummus monoculatus Odontochitina costata, O.operculata, Oligosphaeridium complex, Palaeohystrichophora infusorioides, Pervosphaeridium truncatum, Psaligonyaulax deflandrei, Pterodinium cingulatum, Senoniasphaera sp., Spiniferites sp. cf. S.aligerum, S.crassimuratus, S.ramosus, S.ramosus ramosus, Stephodinium coronatum, Surculosphaeridium longifurcatum, Systematophora complicata Neale and Sarjeant, Trichodinium castanea, Wallodinium anglicum, Xenacus ceratoides (Deflandre) Lentin and Williams, Xiphodhoridium alatum.
Other algae: Micrhystidium sp.
Misc.: foraminiferal linings.

Comments
A middle Cenomanian age is indicated by the presence of M.ornatum, S.crassimuratus, X.ceratioides and M.irregulare in association with E.spinosa and L.siphoniphorum. An abundance of diverse dinoflagellate cysts and common foraminiferal test-linings together with some tracheidal debris reflect an inner to mid-shelf environment of deposition.

Within the O. mantelliana horizon, 1.5 m below the prominent change in lithology, there are marl seams that are sample locality 22.

CC/MBH 9.

FORAMINIFERA (MBH)
Ammodiscus cretaceus, Arenobulimina advena, A.courta, A.depressa, Dorothia gradata, Eggerellina mariae Ten Dam, Gaudryina austinana Cushman, G.quadrans Cushman, Marssonella trochus, Plectina cenomana Carter and Hart, P.mariae, Pseudotextulanella cretosa, Spiroplectinata annectens, Spiroplectammina rectangularis Ten Dam, Textularia chapmani Lalicker, Tritaxia pyramidata Reuss, Citharinella chapmanni Marie, Dentalina distincta Reuss, Edithaella sessilis Fuchs, Frondicularia archiaciana d'Orbigny, F.cordai Reuss, Gavelinella baltica Brotzen, G.cenomanica, G.intermedia, G.reussi, Globulina lacrima Reuss, Gyroidinoides parva, Lenticulina ex. gp. rotulata, Lingulogavelinella turonica, Lingulonodosaria semiornata Reuss, Marginulina jonesi, Ramulina aculeata Wright, R.muricatina Loeblich and Tappa, Saracenaria jarvisi, Spiroloculina papyracea Burrows, Sherborn and Bailey, Vaginulina ex. gp. kochii Roemer, Guembilitria harrisi Tappan, Hedbergella delnoensis, H.planispira, H.brittonensis Loeblich and Tappan, Heterohelix moremani, Rotalipora appeninica.

Comments
R.appeninica, A.advena, P.cenomana and P.cretosa indicate a Middle Cenomanian age. Open shelf marine fauna.

OSTRACODA (PPEW)
Cytherella ovata.

CALCAREOUS NANNOFOSSILS (JAB)
Rhagodiscus angustus, Eiffellithus turriseiffelii, Biscutum ellipticum, Prediscosphaera avitus, Helicolithus trabeculatus, Broinsonia enormis, Watznaueria barnesae, Ellipsagelopshaera fossacincta, Lithraphidites carniolensis, Prediscosphaera cretacea, Tranolithus orionatus, Zeugrhabdotus erectus, Rhagodiscus asper, Rhagodiscus achlyostaurion, Retecapsa crenulata, Eprolithus floralis, Glaukolithus diplogrammus, Chiastozygus litterarius, Ellipsagelosphaera ovata, Rhagodiscus splendens, Zeugrhabdotus embergeri, Cretarhabdus striatus, Discorhabdus ignotus, Staurolithites crux, Nannoconus regularis, Manivitella pemmatoidea, Gartnerago obliquum, Rhagodiscus plebeius, Glaukolithus compactus, Axopodorhabdus albianus, Radiolithus planus, Braarudosphaera regularis, Seribiscutum primitivum, Cribrosphaerella ehrenbergii.

Comments
Age diagnostic fossils - R.achlyostaurion (Upper Aptian - Mid Turonian), A.albianus (Mid Albian - Lower Turonian), G.obliquum (Upper Cenomanian - Maastrichtian).

PALYNOMORPHS (DJB,JKL,AMM)
Dinoflagellate cysts: Achomosphaera ramulifera, Batiacasphaera sp., Callaiosphaeridium asymmetricum, Cassiculosphaeridia sp., Cleistosphaeridium armatum, C.huguoniotii, Coronifera striolata, Cyclonephelium distinctum, Dapsilidinium warrenii, Ellipsodinium distinctum, Endoscrinium campanula, Exochosphaeridium bifidum, E.phragmites, Florentinia laciniata, F.stellata, Hystrichodinium pulchrum, Kiokansium polypes, Litosphaeridium siphoniphorum, Membranilarnacia polycladiata, Microdinium irregulare, M.setosum, Odontochitina costata, O.operculata, Oligosphaeridium complex, Palaeohystrichophora infusorioides, Pervosphaeridium pseudhystrichodinium, P.truncatum, Psaligonyaulax deflandrei, Pterodinium cingulatum, P.cingulatum granulatum, Spiniferites ramosus, S.ramosus ramosus, Tanyosphaeridium varieculamus, Trichodinium castanea, Xenacus ceratoides (Deflandre) Lentin and Williams, Xiphodhoridium alatum.
Other algae: Cymatiosphaera radiata O. Wetzel.

Comments
A middle Cenomanian age is indicated by the presence of X.ceratioides and M.irregulare in association with E.spinosa and L.siphoniphorum. This horizon marks the last appearance of E.spinosa, thus indicating the top of the Clarke and Verdier's Epelidosphaeridia spinosa subzone. The inertinite-dominated phytoclast component, the absence of miospores and the presence of numerous dinoflagellate cysts, particularly chorate morphotypes, suggest an outer shelf environment of deposition.

In the more massive chalk immediately above the marked change in lithology, and within the lower part of the R.cushmani Zone, is to be found sample locality 23.

Sample CC/MBH 10.

FORAMINIFERA (MBH)
Ammodiscus cretaceus, Arenobulimina advena, Dorothia gradata, Marssoneila trochus, Plectina cenomana Carter and Hart, P.mariae, Textularia chapmani Lalicker, Tritaxia macfadyeni Cushman, T.pyramidata Reuss, Frondicularia cordai Reuss, Gavelinella balhca Brotzen, G.cenomanica, G.intermedia, G.reussi, Gyroidinoides parva, Lenticulina sp. gp. rotulata, Lingulogavelinella turonica, Palmula cordata, Ramulina aculeata Wright, Saracenaria bononiensis, S.jarvisi, Vaginulina ex. gp. kochii Roemer, Guembilitria harrisi Tappan, Hedbergella delnoensis, H.brittonensis Loeblich and Tappan, Heterohelix moremani, Praeglobotruncana stephani, Rotalipora cushmani, R.greenhornensis.

Comments
R.cushmani and R.greenhornensis indicate a late Middle Cenomanian age. Open shelf marine fauna - abundant planktonic foraminifera.

OSTRACODA (PPEW)
No ostracods recovered.

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae, Biscutum ellipticum, Broinsonia enormis, Tranolithus orionatus, ?Gartnerago obliquum, Discorhabdus ignotus, Rotelapillus laffittei, Rhagodiscus angustus, Retecapsa crenulata, Eiffellithus turriseiffelii, Lithraphidites carniolensis, Prediscosphaera cretacea, Staurolithites crux, Rhagodiscus achlyostaurion, Axopodorhabdus albianus, Glaukolithus compactus, Cylindralithus serratus, Retecapsa angustiforata, Prediscosphaera avitus, Zeugrhabdotus erectus, Bipodorhabdus brooksii, Microstaurus chiastius, Ellisagelosphaera fossacincta, Radiolithus planus, Chiastozygus litterarius, Eprolithus floralis, Corollithion kennedyi, Zeugrhabdotus embergeri, Scapholithus fossilis, Helicolithus trabeculatus.

Comments
Age diagnostic fossils - R.achlyostaurion (Upper Aptian - Mid Turonian), A.albianus (Mid Albian - Lower Turonian), M.chiastius (Lower Hauterivian - Upper Cenomanian), C.kennedyi (Lower Cenomanian - Mid Cenomanian).

PALYNOMORPHS (DJB,JKL,AAM)
Miospores: Alisporites sp., Deltoidospora sp., Gleicheniidites senonicus Skarby.
Dinoflagellate cysts: Achomosphaera crassipellis, A.ramulifera, Callaiosphaeridium asymmetricum, Carpodinium obliquicostatum, Cassiculosphaeridia reticulata, Chatangiella sp., Cleistosphaeridium aciculare, C.armatum, C.huguoniotii, C.huguoniotii pertusum, Coronifera striolata, Cyclonephelium distinctum, Dapsilidinium laminaspinosum, Ellipsodinium rugulosum, Ellipsoidictyum circulatum, Endoscrinium campanula, Exochosphaeridium arnace, E.bifidum, E.phragmites, Florentinia laciniata, F.mantellii, F.radiculata, F.stellata, Gonyaulacysta cassidata, Hystrichodinium pulchrum, Hystrichosphaeridium bowerbankii, H.recurvatum, Hystrichostrogylon membraniphorum, Isabelidinium sp., Leberidocysta chlamydata, L.defloccata, Litosphaeridium siphoniphorum, Membranilarnacia

polycladiata, Microdinium crinitum, M.irregulare, Odontochitina costata, O.operculata, Palaeohystrichophora infusorioides, Pervosphaeridium cenomaniense, P.pseudhystrichodinium, P.truncatum, Psaligonyaulax deflandrei, Pterodinium cingulatum, Spiniferites crassimuratus, S.ramosus, S.ramosus ramosus, Stephodinium coronatum, Trichodinium castanea, Wallodinium anglicum, Xiphodhoridium alatum.
Other algae: Cymatiosphaera radiata O. Wetzel, Pterospermella sp.

Comments
The absence of E.spinosa at this horizon is significant in marking the base of Clarke and Verdier's (1967) upper subdivision of the Cenomanian, the Cleistosphaeridium huguoniotii subzone. (The base of this dinocyst subzone occurs above the base of the Holaster subglobosus (macrofossil) Zone. Characteristic components present in this sample, include C.huguoniotii, C.obliquicostatum, S.crassimuratus, P.deflandrei and L.siphoniphorum. A transgressive peak may be indicated by the abundance and marked increase in species diversity of the dinoflagellates, accompanied by an impoverished, entirely inertinitic kerogen content, very few miospores and the absence of benthonic foraminferal test-linings.

Two hundred metres further east along the beach the A.plenus Marls come down to beach level. These thin marls and interbedded limestones mark a very distincive series of faunal changes that are the direct result of the Late Cenomanian oceanic anoxic event (Hart and Ball 1986; Hart and Swiecicki 1987). Because of the importance of this horizon five sample points are suggested. Sample locality 24 is located 4m below the sub-plenus erosion surface.

Sample CC/MBH3

FORAMINIFERA (MBH)
Arenobulimina advena, A.depressa, Dorothia gradata, Eggerellina mariae Ten Dam, Plectina cenomana Carter and Hart, P.mariae, Textularia sp., Tritaxia macfadyeni Cushman, T.pyramidata Reuss, Edithaella sessilis Fuchs, Gavelinella baltica Brotzen, G.cenomanica, G.intermedia, Lenticulina ex. gp. rotulata, Saracenaria jarvisi, Guembilitria harrisi Tappan, Hedbergella delrioensis, H.planispira, Heterohelix moremani, Praeglobotrunca stephani, Rotalipora cushmani.

Comments:
R.cushmani and P.stephani indicate a Late Cenomanian age.

OSTRACODA (PPEW)
Virtually barren.

CALCAREOUS NANNOFOSSILS (JAB)
Ellipsagelosphaera fossacincta, Watznaueria barnesae, Zeugrhabdotus

erectus, Chiastozygus litterarius, Retecapsa angustiforata, Biscutum ellipticum, Prediscosphaera cretacea, Broinsonia enormis, Eprolithus floralis, Tranolithus gabalus, Glaukolithus compactus, Eiffellithus turriseiffelii, Rhagodiscus achlyostaurion, Rhagodiscus asper, Rhagodiscus angustus, Retecapsa crenulata, Radiolithus planus, Manivitella pemmatoidea, Tranolithus orionatus, Lithraphidites carniolensis, Nannoconus sp., Broinsonia signata, Cribrosphaerella ehrenbergii, Helicolithus trabeculatus, Cyclagelosphaera margereli, Ellipsagelosphaera ovata, Tranolithus minimus, Gartnerago obliquum, Braarudosphaera regularis, Lithraphidites acutum, Discorhabdus ignotus, Axopodorhabdus albianus, Microstaurus chiastius, Rhagodiscus plebius.

Comments
Age diagnostic fossils - R.achlyostaurion (Upper Aptian - Mid Turonian), L.acutum (Mid Cenomanian - Upper Cenomanian), A.albianus (Mid Albian - Lower Turonian), M.chiastius (Lower Hauterivian - Upper Cenomanian).

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Alisporites spp., Gleicheniidites apilobatus Webster, Laevightosporites ovatus Wilson and Webster.
Dinoflagellate cysts: Achomosphaera crassipellis, A.ramulifera, Apteodinium sp., Cassaiosphaeridium asymmetricum, Carpodinium obliquicostatum, Cleistosphaeridium aciculare, C.huguoniotii, C.huguoniotii pertusum, C.multifurcatum, Coronifera oceanica, C.striolata, Cyclonephelium distinctum, Dapsilidinium laminaspinosum, Ellipsodinium rugulosum, Ellipsoidictyum circulatum, E.imperfectum, Endoscrinium campanula, Exochosphaeridium arnace, E.bifidum, Florentinia mantellii, F.radiculata, F.stellata, Fromea fragilis (Cookson and Eisenack) Stover and Evitt, Hystrichodinium pulchrum, Hystrichosphaeridium bowerbankii, H.recurvatum, Hystrichostrogylon membraniphorum, Kiokansium polypes, Kleithiasphaeridium readei, Leberidocysta chlamydata, L.defloccata, Litosphaeridium siphoniphorum, Membranilarnacia polycladiata, Microdinium irregulare, M.ornatum, M.setosum, M. sp. cf. M.setosum, Odontochitina costata, Oligosphaeridium asterigerum, O.complex, Palaeohystrichophora infusorioides, Pareodinia sp., Pervosphaeridium cenomaniense, P.pseudhystrichodinium, P.truncatum, Pterodinium cingulatum, P.cingulatum granulatum, Spiniferites compactus, S.crassimuratus, S.ramosus, S.ramosus ramosus, Stephodinium coronatum, Surculosphaeridium longifurcatum, Trichodinium castanea, Wallodinium anglicum, Xiphodhoridium alatum.
Other algae: Eyrea nebulosa Cookson and Eisenack.

Comments
A late middle - late Cenomanian age is indicated by the presence of species characteristic of the Cleistosphaeridium huguoniotti subzone of Clarke and Verdier (1967), viz. L.siphoniphorum, C.obliquicostatum, C.huguoniotii, M.setosum and S.crassimuratus. An abundance of morphologically diverse dinocysts and a low content of terrestrially - sourced material suggest an outer shelf environment of deposition. The absence of benthonic foraminiferal test-linings and acanthomorph acritarchs is consistent with a deep water facies.

Sample locality 25 is located 25 cms above the base of the A.plenus Marls.

Sample CC/MBH 5.

FORAMINIFERA (MBH)
Arenobulimina advena, A.depressa, Dorothia gradata, Eggerellina mariae Ten Dam, Marssonella trochus, Plectina cenomana Carter and Hart, P.mariae, Textularia chapmani Lalicker, Tritaxia macfadyeni Cushman, T.pyramidata Reuss, Gavelinella baltica Brotzen, G.cenomanica, G.intermedia, Gyroidinoides parva, Leniticulina ex. gp. rotulata, Lingulogavelinella sp., Ramulina muricatina Loeblich and Tappan, Saracenaria jarvisi, Vaginulina ex. gp. kochii Roemer, Guembilitria harrisi Tappan, Hedbergella delrioensis, H.brittonensis Loeblich and Tappan, Heterohelix moremani, Praeglobotruncana stephani, Rotalipora cushmani, R.greenhornensis, Whiteinella sp.

Comments
R.cushmani, R.greenhornensis and Whiteinella sp. indicate a latest Cenomanian age. Open shelf marine faunas.

OSTRACODA (PPEW)
Cytherelloidea bonnemai Weaver, Cytherella ovata, *Pontocyprella robusta Weaver, Bairdoppilata pseudoseptentrionalis Mertens, Pterygocythereis robusta, *Cornicythereis larivourensis, Cytherella gruendeli Weaver, *Neocythere kayei Weaver, *Pontocyprella robusta Weaver, Cytherella ovata, Cytherella ovata, Cytherella cf. C. truncata, *Oertliella alata Weaver, Monoceratina umbonata, Monoceratina pedata, Pontocyprella harrisiana, Cytherella medwayensis Weaver.

Comments
Age diagnostic fossils - Those marked with*. See ranges in Weaver (1982).

CALCAREOUS NANNOFOSSILS (JAB)
Rhagodiscus achlyostaurion, Watznaueria barnesae, Retecapsa crenulata, Prediscosphaera cretacea, Biscutum ellipticum, Ellipsagelosphaera fossacincta, Tranolithus orionatus, Lithraphidites carniolensis, Eiffellithus turriseiffelii, Eprolithus floralis, Ahmuellerella octoradiata, Rhagodiscus angustus, Broinsonia enormis, Corollithion signum, Rhagodiscus asper, Zeugrhabdotus erectus, Prediscosphaera avitus, Manivitella pemmatoidea, Chiastozygus litterarius, Axopodorhabdus albianus, Rotelapillus laffittei, Ellipsagelosphaera ovata, Retecapsa angustiforata, Staurolithites crux, Scapholithus fossilis, Lithraphidites acutum, Cyclagelosphaera margereli, Radiolithus planus, Helicolithus trabeculatus, Stoverius biarcus, Zeugrhabdotus embergeri, Zeugrhabdotus ponticulus.

Comments
Age diagnostic fossils - R.achlyostaurion (Upper Aptian - Mid Turonian), A.albianus (Mid Albian - Lower Turonian), L.acutum (Mid Cenomanian - Upper Cenomanian).

PALYNOLOGY (DJB,JKL,AMM)
Miospores: Alisporites sp., Cicatriocosisporites sp., Cyathidites minor Couper, Parvisaccites granisaccus Hedlund.
Dinoflagellate cysts: Achomosphaera crassipellis, Cassaiosphaeridium asymmetricum, Cassiculosphaeridia reticulata, Cleistosphaeridium aciculare, C.armatum, C.huguoniotii, C.multifurcatum,

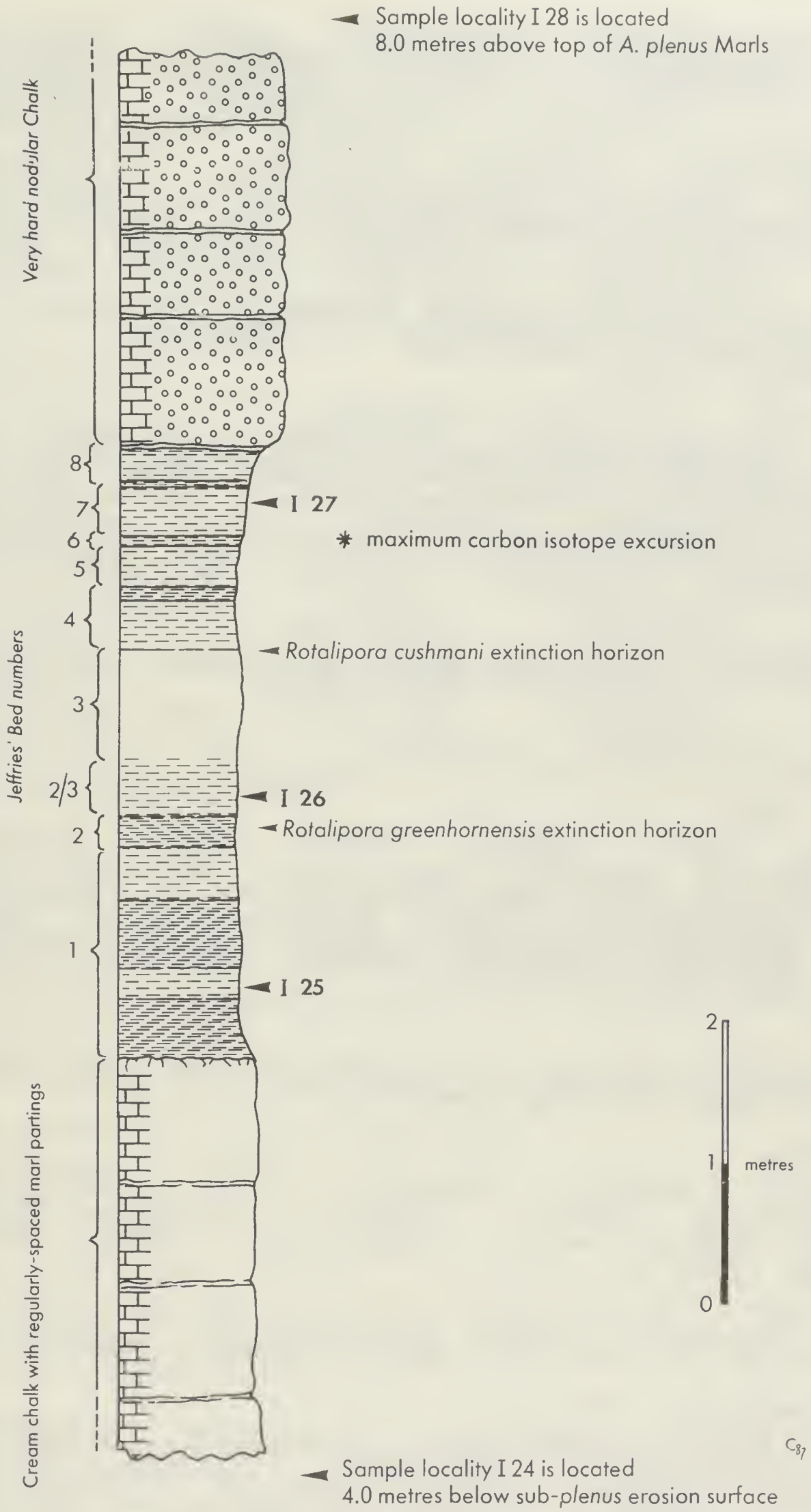


Figure 13. Culver Cliff (Sample Localities 24-28). A considerable distance along the foot of the main cliff there is exposed a good section in the A.plenus Marls, which is the on-shore expression of oceanic anoxic event 2. Sample 28 is located in the nodular chalks of the early Turonian while the remainder of the sample localities are late Cenomanian in age. The sample localities have been chosen to identify the major changes seen at this level. Recent work by Carson (Liverpool University) on carbon isotopes allows identification of maximum carbon excursion in Bed 6 (Jefferies 1963). The major change in the benthonic Foraminifera occurs at the top of Bed 1.

Cyclonephelium distinctum, Dapsilidinium pumilum, Endoscrinium campanula, Exochosphaeridium bifidum, Florentinia mantellii, F.radiculata, F.stellata, Hystrichodinium pulchrum, Hystrichosphaeridium bowerbankii, H.recurvatum, Kleithiasphaeridium readei, Leberidocysta chlamydata, L.defloccata, Litosphaeridium siphoniphorum, Microdinium crinitum, M.irregulare, Odontochitina costata, Oligosphaeridium complex, Paleodinia sp., Pervosphaeridium cenomaniense, P.truncatum, Pterodinium cingulatum, P.sp., Spiniferites crassimuratus, S.ramosus, S.ramosus ramosus, Subtilisphaera sp., Trichodinium castanea, Xiphodhoridium alatum.
Other algae: Eyrea nebulosa, Micrhystridium sp., Veryhachium sp..
Misc.: foraminiferal linings.

Comments
The presence of L.siphoniphorum and S.crassimuratus precludes an age younger than the latest Cenomanian-earliest Turonian boundary (top of Clarke and Verdier's (1967) L.siphoniphorum Zone). The abundance of dinocysts together with a few foraminiferal linings and some amorphous organic matter suggest that depostion took place in a quiet, inner neritic shelf environment.

Sample locality 26 is located 150cms above the base of the A.plenus Marls.

Sample CC/MBH 6.

FORAMINIFERA (MBH)
Arenobulimina preslii, Gaudryina quadrans Cushman, Marsonella trochus, Textularia chapmani Lalicker, Tritaxia tricarinata Reuss, Frondicularia archiaciana d'Orbigny, Gavelinella ex. gp. ammonoides/ intermedia, Lingulogavelinella globosa, Guembilitria harrisi Tappan, Hedbergella delrioensis, Heterohelix moremani, Rotalipora cushmani, Schackoina cenomana, Whiteinella sp.

Comments
Rotalipora cushmani indicates a latest Cenomanian age. Very reduced benthonic fauna, shows increasing effect of oceanic anoxic event.

OSTRACODA (PPEW)
Pterygocythereis robusta, Cytherella ovata, Bairdoppilata pseudoseptentrionalis Mertens, Cytherella gruendeli Weaver, *Pontocyprella robusta Weaver, *Isocythereis elongata Weaver, Cytherella spp. (juveniles).

Comments
Age diagnostic fossils - Those marked with *. See ranges in Weaver (1982).

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae, Rhagodiscus achlyostaurion, Zeugrhabdotus erectus, Cribrosphaerella ehrenbergii, Eprolithus floralis, Prediscosphaera cretacea, Biscutum ellipticum, Lithraphidites carniolensis, Broinsona enormis, Tranolithus orionatus, Lithraphidites acutum, Ellipsagelosphaera ovata, Eiffellithus turriseiffelii, Chiastozygus litterarius Retecapsa crenulata, Helicolithus trabeculatus, Calculites obscurus, Discorhabdus ignotus, Haqius circumradiatus, Glaukolithus compactus, Cylindralithus serratus, Radiolithus planus, Cretarhabdus striatus,

Rhagodiscus angustus, Rotelapillus laffittei, Cyclagelosphaera margereli, Thoracosphaera sp., Prediscosphaera avitus, Ahmuellerella octoradiata, Microstaurus chiastius, Zeugrhabdotus embergeri.

Comments
Age diagnostic fossils - R.achlyostaurion (Upper Aptian - Mid Turonian), L.acutum (Mid Cenomanian - Upper Cenomanian), M.chiastius (Lower Hauterivian - Upper Cenomanian).

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Alisporites sp., Gleicheniidites apilobatus Brenner, G. senonicus Skarby.
Dinoflagellate cysts: Achomosphaera crassipellis, Apteodinium sp., Callaiosphaeridium asymmetricum, Cassiculosphaeridia reticulata, Cleistosphaeridium aciculare, C.huguoniotii, Coronifera oceanica, Disphaera munda, Ellipsodinium rugulosum, Endoscrinium campanula, Florentinia ferox, F.laciniata, F.radiculata, F.stellata, Gonyaulacysta cassidata, Hystrichodinium pulchrum, Hystrichosphaeridium bowerbankii, H.recurvatum, Kiokansium polypes, Kleithiasphaeridium readei, Leberidocysta defloccata, Litosphaeridium siphoniphorum, Microdinium irregulare, Odontochitina costata, Oligosphaeridium complex, Palaeohystrichophora infusorioides, Pervosphaeridium cenomaniense, P.truncatum, Prolixosphaeridium parvispinum, Pterodinium . cingulatum, Senoniasphaera sp., Spiniferites crassimuratus, S.ramosus, S.ramosus ramosus, Trichodinium castanea, Xiphodhoridium alatum.
Misc.: foraminiferal linings.

Comments
The presence of L.siphoniphorum, G.cassidata and S.crassimuratus suggests a latest Cenomanian - earliest Turonian age. The presence of small amounts of inertinitic debris and rare miospores in conjunction with common foraminiferal test-linings and abundant dinocysts suggest a mid-outer shelf environment of deposition.

Sample locality 27 is located above the main carbon isotope excursion,

30cms below the top of the A.plenus Marls.

Sample CC/MBH 4.

FORAMINIFERA (MBH)
Marssonella trochus, Gavelinella tourainensis Butt, Lenticulina ex. gp. rotulata, Lingulogavelinella globosa, Hedbergella delnoensis, Whiteinella archaeocretacea Pessagno.

Comments
W.archaeocretacea indicates a latest Cenomanian age. Very reduced, almost monospecific (L.globosa) benthonic fauna. Poorly preserved planktonic species. Near-anoxic conditions on substrate, poor planktonic fauna following carbon excursion.

OSTRACODA (PPEW)
Cytherelloidea stricta, Cytherella gruendeli Weaver, C.ovata.

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae, Eprolithus floralis, Prediscosphaera cretacea, Cyclagelosphaera margereli, Broinsonia enormis, Eiffellithus turriseiffelii, Biscutum ellipticum, Tranolithus orionatus, Discorhabdus ignotus, Rhagodiscus achlyostaurion, Lithraphidites carniolensis, Prediscosphaera avitus, Retecapsa crenulata, Zeugrhabdotus erectus, Z.embergeri, Helicolithus trabeculatus, Broinsonia signata, Glaukolithus compactus, Haqius circumradiatus, Rhagodiscus angustus, Braarudosphaera bigelowii, Rhagodiscus asper, Chiastozygus litterarius, Retecapsa angustiforata, Ahmuellerella octoradiata, Microstaurus chiastius, Gartnerago obliquum.

Comments
Age diagnostic fossils - R.acylyostaurion (Upper Aptian - Mid Turonian), M.chiastius (Lower Hauterivian - Upper Cenomanian), ?G.obliquum (Upper Cenomanian - Maastrichtian).

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Cyathidites minor Couper.
Dinoflagellate cysts: Achomosphaera crassipellis, A.ramulifera, Adnatodsphaeridium tutulosum (Cookson and Eisenack) Morgan, Callaiosphaeridium asymmetricum, Cassiculosphaeridia reticulata, Chytroeisphaeridia ringnesiorum (Manum and Cookson) Morgan, Cleistosphaeridium aciculare, C.armatum, C.flexuosum, C.huguoniotii, C.multifurcatum, Coronifera oceanica, Cyclonephelium distinctum, C.membraniphorum, Dapsilidinium laminaspinosum, D.warrenii, Endoscrinium campanula, Exochosphaeridium phragmites, Florentinia ferox, F.radiculata, F.stellata, Hystrichodinium pulchrum, Hystrichosphaeridium bowerbankii, Kleithiasphaeridium readei, K.sp. cf. K.sarmentum Below, Leberidocysta defloccata, Litosphaeridium sp., Microdinium crinitum, M.irregulare, Odontochitina costata, Oligosphaeridium complex, Palaeohystrichophora infusorioides, Pervosphaeridium cenomaniense, P.truncigerum (Deflandre) Yun, Pterodinium sp. cf. P.aliferum, P.cingulatum, P.sp., Spiniferites crassimuratus, S.ramosus, Stephodinium coronatum, Subtilisphaera sp., Surculosphaeridium longifurcatum, Tanyosphaeridium varieculamus, Trichodinium castanea, Xiphodhoridium alatum.

Comments
The absence of L.siphoniphorum from this horizon suggests an earliest Turonian age, as also indicated by the presence of S.crassimuratus. An outer shelf environment is suggested by the occurrence of abundant dinoflagellate cysts dominated by chorate morphotypes and the scarcity of terrestrially derived material.

Sample locality 28 is located 8m above the top of the A.plenus Marls, witnin the lowest levels of the Praeglobotruncana helvetica Zone of the Early Turonian.

Sample CC/MBH 2.

FORAMINIFERA (MBH)
Arenobulimina preslii, Gavelinella ex. gp. ammonoides,

G.tourainensis Butt, Lingulogavelinella globosa, Dicarinella algeriana, D.canaliculata, D.hagni, D.imbricata, Hedbergella delrionensis, Praeglobotruncana helvetica, P.stephani, Whiteinella archaeocretacea Pessagno, W.brittonensis.

Comments
P.helvetica indicates an Early Turonian age. Very reduced benthonic fauna, abundant and diverse planktonic fauna with deeper-water morphotypes. Very poor preservation and difficult sediment to process.

OSTRACODA (PPEW)
No ostracods recovered.

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae, Prediscosphaera cretacea, Helicolithus trabeculatus, Retecapsa crenualata, Eiffellithus turriseiffelii, Rhagodiscus asper, Retecapsa angustiforata, Lithraphidites carniolensis, Tranolithus orionatus, Eprolithus floralis, Cribrosphaerella ehrenbergii, Ellipsagelosphaera ovata, Tranolithus minimum, Zeugrhabdotus erectus, Rotelapillus laffittei, Cretarhabdus striatus, Discorhabdus ignotus, Ellipsagelosphaera fossacincta, Chiastozygus litterarius, Rhagodiscus achlyostaurion, Biscutum ellipticum, Prediscosphaera avitus, Staurolithites crux, Glaukolithus compactus, Broinsonia enormis, Radiolithus planus, Nannoconus regularis, N.truitti rectangularis, Zeugrhabdotus ponticulus, Nannoconus elongatus, Gephyrorhabdus coronadventis.

Comments
Age diagnostic fossils - R.achlyostaurion (Upper Aptian - Mid Turonian). Poor preservation - etched and broken.

PALYNOMORPHS (DJB,JKL,AMM)
Miospores: Alisporites sp., Gleicheniidites sennonicus Skarby, Lycopodiumsporites sp.
Dinoflagellate cysts: Cleistosphaeridium huguoniotii, Coronifera striolata, Cyclonephelium distinctum, C.membraniphorum, Endoscrinium campanula, Exochosphaeridium arnace, E.phragmites, Florentinia stellata, Hystrichodinium pulchrum, Leptodinium sp., Microdinium sp. cf. M.crinitum, Oligosphaeridium asterigerum, O.complex, Pervosphaeridium cenomaniense, Pterodinium aliferum, P.cingulatum, Spiniferites ramosus.

Comments:
An early Turonian age for this sample is based on the absence of latest Cenomanian/earliest Turonian boundary markers (L.siphoniphorum, P.deflandrei, S.crassimuratus, C.obliquicostatum and G.cassidata) in conjunction with the occurrence of E.campanula, which has a range top in the basal Rhynchonella cuvieri (macrofossil) Zone of the early Turonian in the Isle of Wight (Clarke and Verdier, 1967). A sparse dinocyst assemblage and an impoverished kerogen component may indicate deposition in a comparatively shallow, oxidising shelf environments.

Beyond this point the Turonian succession is accessible with severe difficulty. There is no access to Whitecliff Bay along the foot of the cliffs even at the lowest tide, and the continuation of the Cretaceous

succession can only be done by approaching the section from the north (via Whitecliff Bay, Figure 10).

Whitecliff Bay (SZ640857) Sample localities 29-36 (Figures 10, 14).

The locality is famous for the almost continuous outcrop of Palaeogene strata in the back of the bay. At low tide, however, it is possible to round the point, cross Whitecliff Ledge, climb round White Horse Ledge and even reach the uppermost Turonian strata by The Nostrils. This cannot be done on anything but a falling tide and must not be attempted when there is a moderate wind. It should also not be attempted alone as even the slightest accident could result in drowning if nobody was available to summon assistance. The succession was first described in detail by Rowe (1908) but he unfortunately made an error in his notebook that has been handed down to later workers, notably Barr (1962) and Clarke and Verdier (1966). The section shown in Figure 14 is a diagrammatic summary of a totally re-measured succession of chalks that range in age from the lastest Turonian to the earliest Late Campanian. Macrofossils are rare throughout and the placing of macrofaunal boundaries is exceptionally difficult. Much of the succession is a rather monotonous sequence of white chalks with black flints although there is an interesting flint-free section in the Marsupites testudinarius Zone, together with a series of phosphatised and glauconitic hardgrounds at the base of the Offaster pilula Zone.

Sample locality 29 is located on White Horse Ledge in the upper part of the Micraster cortestudinarium Zone.

Sample WB/MBH 4.

FORAMINIFERA (MBH)
Verneuilina munsteri Reuss, Eovigerina stormi Brotzen, Gavelinella pertusa, Globorotalites micheliniana, Lingulogavelinella sp. cf.

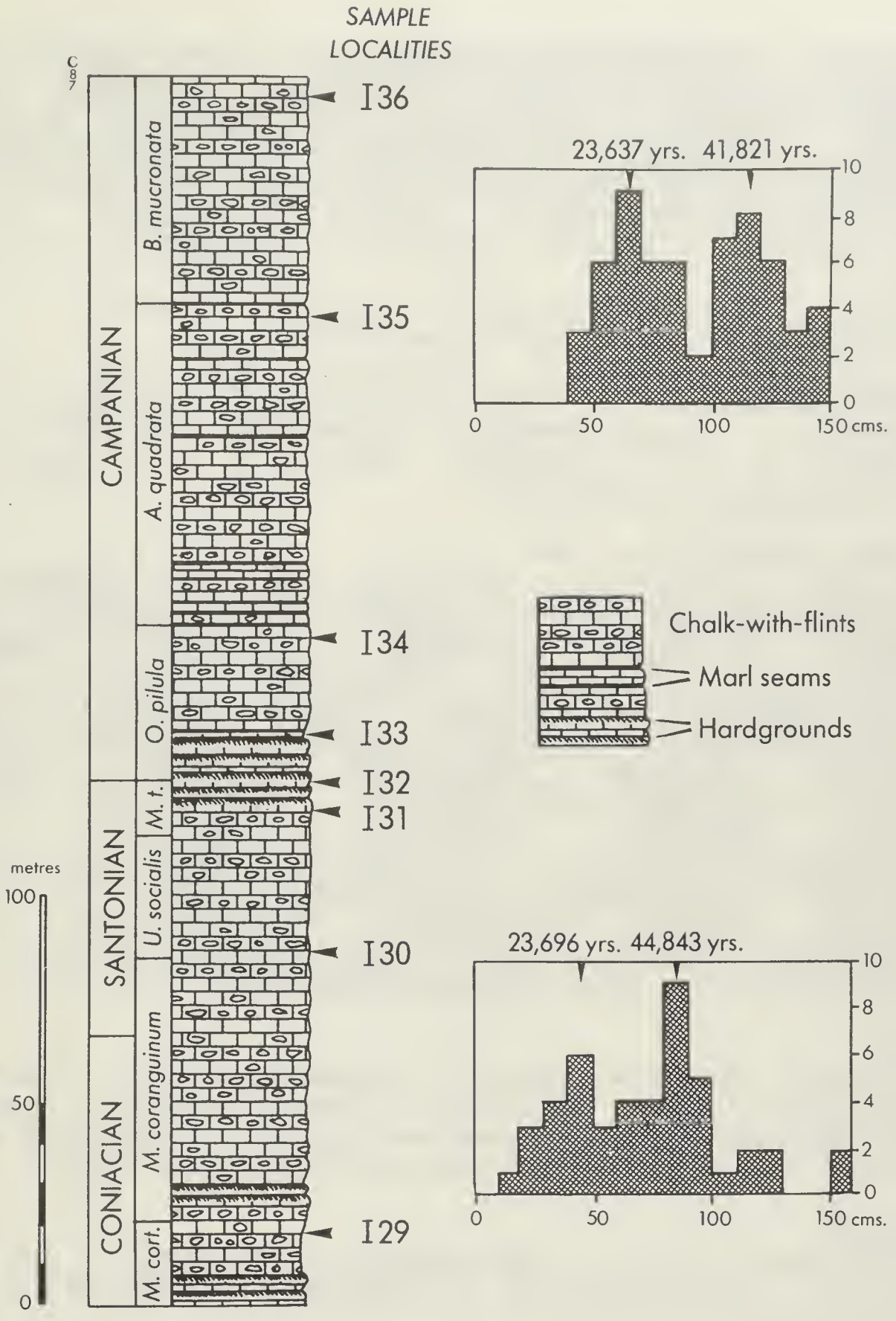


Figure 14. Whitecliff Bay (Sample Localities 29-36). This succession of chalk-with-flints and chalks with phosphatised hardgrounds can only be approached from the bay to the north. It is a very dangerous section and the sampling of the Coniacian involves climbing along the foot of the cliffs. Recent work on cycles of flint bands has shown that in the Coniacian and Middle Campanian there are distinctive frequencies that can possibly be attributed to orbital parameters. If one selects each peak in turn and calculates the number of ideal cyles in each interval and the predicted duration from radiometric data then one can arrive at the figures given above. Each calculation gives a figure remarkably close to the values of 23,000 years and 41,500 years that give the Milankovich periodicity.

L.vombensis, Neoflabellina baudouiniana, N.praerugosa Hiltermann, Reussella kelleri Vasilenko, Valvulineria lenticula Heterohelix globulosa, H.reussi, Dicarinella canaliculata, Marginotruncana marginata, M.pseudolinneiana Pessagno, Whiteinella baltica Douglas and Rankin, W.brittonensis, very rare Globotruncana bulloides Vogler, very rare Marginotruncana renzi.

Comments
G.bulloides, M.pseudolinneiana and W.baltica indicate an Early to Mid-Cenomanaian age. Open shelf marine fauna.

OSTRACODA (PPEW)
Bairdoppilata septentrionalis, Cytherella ovata, C. cf. C.truncata, C. cf. C.gruendeli Weaver, C. cf. C.contracta van Veen, Phacorhabdotus lonsdaleina.

CALCAREOUS NANNOFOSSILS (JAB)
Helicolithus trabeculatus, Watznaueria barnesae, Ellipsagelosphaera fossacincta, Prediscosphaera cretacea, Micula decussata, Gartnerago obliquum, Helicolithus anceps, Manivitella pemmatoidea, Cribrosphaerella ehrenbergii, Glaukolithus compactus, Calculites obscurus (occasional), Broinsonia enormis, Kamptnerius magnificus, Retecapsa crenulata, Tranolithus orionatus, Retecapsa angustiforata, Eiffellithus eximius, Lithraphidites carniolensis, Cretarhabdus striatus, Braarudosphaera bigelowii, Lucianorhabdus quadrifidus, Eprolithus floralis, Lithastrinus septenarius, Eiffellithus turriseiffelii, Quadrum gartneri, Rhagodiscus splendens, Glaukolithus diplogrammus, Rhagodiscus asper, Braarudosphaera regularis, Haqius circumradiatus, Lucianorhabdus maleformis, Cylindralithus serratus, Reinhardtites anthophorus, Micula concava, Lithastrinus grillii, Zeugrhabdotus ponticulus.

Comments
Age diagnostic fossils - M.decussata (Upper Coniacian - Maastrichtian), L.septenarius (Lower Coniacian - Upper Santonian), R.anthophorus (Lower Santonian - Upper Campanian), L.grilli (Lower Santonian - Upper Campanian), M.concava (Lower Santonian-?). Poor preservation.

Palynomorphs (BAT)
Dinoflagellate cysts: Achomosphaera ramulifera, Cyclonephelium distinctum, Heteropshaeridium? heteracanthum Eisenack and Kjellstrom, Palaeohystrichophora infusorioides, Surculosphaeridium? lonifurcatum.

Sample locality 30 is just up the foot of a large cliff fall at the Micraster coranguinium/Uintacrinus socialis boundary (which is almost impossible to locate because of the lack of macrofauna.

Sample WB/MBH 3.

FORAMINIFERA (MBH)
Verneuilina munsteri Reuss, Cibicides beaumontianus, C.ribbingi Brotzen, Gavelinella pertura, G.thalmanni, Globorotalites micheliniana, Loxostomum eleyi, Neoflabellina baudouinana, N.praerugosa Hiltermann, Osangularia whitei, Praebulimina reussi,

Reussella kelleri Vasilenko, R.szajnochae praecursor Deklasz and Knipscheer, Stensioina exsculpta exsculpta, S.granulata granulata, S.granulata polonica, Vaginulinopsis scalariformis Porthault, Valvulineria lenticula, Archaeoglobigerina bosquensis Pessagno, Dicarinella conavata, Globotruncana bulloides Vogler, G.linneiana, Heterohelix globulosa, H.reussi, Dicarinella canaliculata, Marginotruncana pseudolinneiana Pessagno, Whiteinella baltica Douglas and Rankin.

Comments ·
D.concavata, S.exsculpta exsculpta, S.granulata granulata and S.granulata polonica indicate an Early Santonian age. Open shelf, marine fauna, some deeper-water planktonic morphotypes.

OSTRACODA (PPEW)
Cytherella sp.

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae, Prediscosphaera cretacea, Helicolithus anceps, Arkhangelskiella cymbiformis, Nannoconus regularis, Eiffellithus turriseiffelii, Lithraphidites carniolensis, Retecapsa angustiforata, Quadrum gartneri, Glaukolithus compactus, Micula decussata, Eiffellithus eximius, Cribrosphaerella ehrenbergii, Microrhabdulus decoratus, Manivitella pemmatoidea, Calculites ovalis, Broinsonia enormis, Lucianorhabdus cayeuxii, Cretarhabdus striatus, Glaukolithus diplogrammus, Lithastrinus grillii, Cylindralithus serratus, Retecapsa crenulata, Biscutum ellipticum, Rhagodiscus splendens, Calculites obscurus (occasional), Tranolithus orionatus, Micula concava, Gartnerago obliquum, Eprolithus floralis, Ellipsagelosphaera fossacincta, Braarudosphaera regularis, B.bigelowii, Haqius circumradiatus.

Comments
Age diagnostic fossils - L.cayeuxii (coranguinum/socialis Zone, Mid Santonian - ?), E.floralis (martinoides Zone, Upper Aptian - Lower Campanian), M.concava (Lower Santonian - ?), L.grillii (coranguinum Zone, Lower Santonian - Upper Campanian).

PALYNOMORPHS (BAT)
Dinoflagellate cysts: Cyclonephelium compactum, Heterosphaeridium? heteracanthum, Senoniasphaera rotunda.

Comments
The presence of C.compactum and S.rotunda indicates an age no older than early Turonian and no younger than Santonian.

Sample locality 31 is in the lower part of the M.testudinarius Zone immediately below the interval that contains no flints.

Sample WB/MBH 2.

FORAMINIFERA (MBH)
Verneuilina munsteri Reuss, Cibicides beaumontianus, C.ribbingi Brotzen, Eovigerina aculeata, Eponides concinna Brotzen, Gavelinella cristata cristata, G.lorneiana, G.pertusa, G.stelligera,

G.thalmanni, Globorotalites micheliniana, Loxostomum eleyi, Osangularia whitei, Praebulimina carseyae, P.reussi, Reussella kelleri Vasilenko, Stensioina exsculpta gracilis Brotzen, Valvulineria leticula, Archaeoglobigerina cretacea Pessagno, Globotruncana bulloides Vogler, G.linneiana.

Comments
S.exsculpta gracilis and R.kelleri indicate a Late Santonian age. Open shelf marine forms.

OSTRACODA (PPEW)
Neocythere virginea, Cythereis spp., Pontocyprella sp., Cytherella ovata, Bairdoppilata septentrionalis, Paracypris?, Idiocythere sp.

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae, Arkhangelskiella cymbiformis, Microrhabdulus decoratus, Prediscosphaera cretacea, Lithraphidites carniolensis, Micula decussata, Retecapsa crenulata, Tranolithus minimus, Retecapsa angustiforata, Calculites obscurus (common), Quadrum gartneri, Tranolithus orionatus, Lucianorhabdus maleformis, Broinsonia enormis, Eiffellithus turriseifelii, E.eximius, Braarudosphaera regularis, Manivitella pemmatoidea, Helicolithus anceps, Cribrosphaerella ehrenbergii, Ellipsagelosphaera fossacincta, Cylindralithus serratus, Lithastrinus septenarius.

Comments
Age diagnostic fossils - L.septenarius (Lower Coniacian - Upper Santonian), common C.obscurus (Upper Santonian - Maastrichtian).

PALYNOMORPHS (BAT)
Dinoflagellate cysts: Achomosphaera ramulifera, Aldorfia deflandrei, Cometodinium? whitei, Dinopterygium cladoides, Exochosphaeridium bifidum, Florentinia ferox, F.radiculata, Hystrichodinium pulchrum, Hystrichosphaeridium palmatum (White) Downie and Sarjeant, H.tubiferum, Hystrichosphaeropsis ovum Deflandre, Hystrichostrogylon membraniphorum, Isabelidinium acuminatum, Odontochitina cribropoda Deflandre and Cookson, Oligosphaeridium complex, Palaeohystrichophora infusorioides, Psaligonyaulax deflandrei, Pterodinium cingulatum cingulatum, Senoniasphaera protrusa Clarke and Verdier, S.rotunda Clarke and Verdier, Spiniferites ramosus ramosus, S.ramosus reticulatus, S.?velatus, Surculosphaeridium ?longifurcatum, Wallodinium anglicum.

Comments
The combined occurrences of D.cladoides, I.acuminatum, S.protrusa and S.?velatus indicate a Santonian age. Overall cyst abundances are low, as is the total organic content. Preservation is poor to moderate.

Sample locality 32 is located in the flint-free chalks of the upper part of the M.testudinarius Zone.

WB/MBH 7.

FORAMINIFERA (MBH)
Arenobulimina obliqua, Marssonella trochus, Orbignyna ovata von

Hagenow, Eponides concinna Brotzen, Gavelinella cristata brotzeni, G.cristata cristata, G.lorneiana, G.pertusa, G.stelligera, G.thalmanni, Globorotalites micheliniana, Gyroidinoides nitida, Osangularia whitei, Praebulimina carseyae, P.reussi, Reussella kelleri Vasilenko, Stensioina exsculpta gracilis Brotzen, S.granulata incondita Koch, Valvulineria lenticula, Archaeoglobigerina cretacea, Heterohelix striata, Rugoglobigerina pilula Belford.

Comments
S.exsculpta gracilis, S.granulata incondita and O.whitei indicate latest Santonian age. Open shelf fauna.

OSTRACODA (PPEW)
Cytherella ovata, Monoceratina sp.

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae, Lithastrinus grillii, Calculites obscurus, Quadrum gartneri, Prediscosphaera cretacea, Gartnerago obliquum, Cribrosphaerella ehrenbergii, Retecapsa angustiforata, Biscutum ellipticum, Eiffellithus eximius, Ellipsagelosphaera ovata, Micula decussata, Discorhabdus ignotus, Glaukolithus compactus, Retecapsa crenulata, Rhagodiscus plebeius, Lucianorhabdus maleformis, Broinsonia enormis, Helicolithus anceps, Reinhardtites anthophorus, Braarudosphaera bigelowii, Tranolithus orionatus, Rhagodiscus angustus, Ellipsagelosphaera fossacincta, Cretarhabdus striatus, Lucianorhabdus cayeuxii, Eiffellithus turriseiffelii, Manivitella pemmatoidea, Lithraphidites carniolensis, Rhagodiscus asper, Broinsonia signata, Cyclagelosphaera margereli, Cylindralithus sp., Braarudosphaera regularis, Micula concava, Praedisosphaera avitus, Lucianorhabdus quadrifidus.

Comments
Age diagnostic fossils - R.anthophorus (Lower Santonian - Upper Campanian), M.concava (Lower Santonian - ?), L.grillii (Lower Santonian - Upper Campanian), L.cayeuxii (Mid Santonian - ?). Occassional W. barnesae coccospheres, overgrowth apparent.

PALYNOMORPHS (BAT)
Dinoflagellate cysts: Achomosphaera crassipellis, A.ramulifera, Aldorfia deflandrei, Cleistosphaeridium armatum, Coronifera striolata, Cyclonephelium expansum Corradini, Dinogymnium microgranulosum Clarke and Verdier, Dinopterygium cladoides, Ellipsodinium rugulosum, Exochosphaeridium bifidum, Florentinia buspina (Davey and Verdier) Duxbury, F.ferox, F.tenera (Davey and Verdier) Duxbury, Hystrichodinium pulchrum, Hystrichosphaeridium palmatum, H.tubiferum, Hystrichosphaeropsis ovum, Hystrichostrogylon membraniphorum, Oligosphaeridium complex, Palaeohystrichophora infusorioides, Rhiptocorys veligera (Deflandre) Lejeune-Carpentier and Sarjeant, Senoniasphaera protrusa Spinidinium echinoideum, Spiniferites multibrevis, S.ramosus gracilis, S.ramosus granosus, S.ramosus ramosus, S.velatus, Surculosphaeridium? longifurcatum, S.spinicongregatum Yun, Wallodinium anglicum, Xenacus ceratoides.

Comments
The occurrence of D.cladoides, E.rugulosum, S.protrusa, S.spinicongregatum and S.?velatus indicates a Santonian age. A rich

and diverse assemblage of dinoflagellate cysts dominated by S.ramosus group, E.bifidum and S.protrusa. Cyst preservation is good.

Sample locality 33 is in the lower part of the O.pilula Zone just above the interval with several hardgrounds.

Sample WB/MBH 8.

FORAMINIFERA (MBH)
Arenobulimina courta, A.footei, A.obliqua, A.pseudorbignyi Marie, Ataxophragmium variabile, Eggerellina brevis, Marssonella trochus, Gavelinella cristata brotzeni, G.cristata cristata, G.lorneiana, G.stelligera, Globorotalites micheliniana, Gyroidinoides nitida, Praebulimina carseyae, Reussella kelleri Vasilenko, Stensioina exsculpta gracilis Brotzen, S.granulata incondita Koch, Valvulineria lenticula, Heterohelix striata.

Comments
G.cristata brozxeni, G.cristata cristata, S.exsculpta gracilis and S.granulata incondita indicate an Early Campanian. Open shelf fauna.

OSTRACODA (PPEW)
Cytherella spp.

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae, Broinsonia enormis, Lithastrinus grillii, Broinsonia parca, Lithraphidites carniolensis, Micula decussata, Calculites obscurus (common), Lucianorhabdus cayeuxii, Prediscosphaera cretacea, Tranolithus orionatus, Tranolithus minimus, Eiffellithus eximius, Arkhangelskiella cymbiformis, Cylindralithus sp., Discorhabdus ignotus, Quadrum gartneri, Microrhabdulus decoratus, Retecapsa crenulata, Biscutum ellipticum, Cribrosphaerella ehrenbergii, Reinharditites anthophorus, Cretarhabdus striatus, Lucianorhabdus arcuatus, Cyclagelosphaera margereli, Lucianorhabdus quadrifidus, Helicolithus anceps, Eiffellithus turriseiffelii, Helicolithus trabeculatus, Lucianorhabdus maleformis, Gartnerago obliquum, Glaukolithus compactus, Braarudosphaera bigelowii, B.regularis, Glaukolithus diplogrammus, Broinsonia signata, Manivitella pemmatoidea, Cribrosphaerella ehrenbergii, Staurolithites crux, Ahmuellerella octoradiata, Rhagodiscus splendens, Retecapsa angustiforata, Zeugrhabdotus elegans, ?Corollithion signum, Rhagodiscus asper, Rhagodiscus plabeius, Nannoconus regularis, Predisosphaera grandis, Nannoconus truitti rectangularis.

Comments
Age diagnostic fossils - B.parca (pilula Zone, Lower Campanian - Lower Maastrichtian), L.grillii (Lower Santonian - Upper Campanian).

PALYNOMORPHS (BAT)
Dinoflagellate cysts: Achomosphaera crassipellis, A.ramulifera, Aldorfia deflandrei, Chatangiella victoriensis (Cookson and Manum) Lentin and Williams, Chlamydophorella discreta Clarke and Verdier, Cleistosphaeridium armatum, Cometodinium? whitei, Coronifera oceanica, C.striolata, Cyclonephelium expansum, Dinogymnium

albertii, D.microgranulosum, Exochosphaeridium bifidum, Florentinia buspina, F.ferox, F.tenera, Heterosphaeridium? heteracanthum, Hystrichodinium pulchrum, Hystrichosphaeridium palmatum, H.tubiferum, Hystrichosphaeropsis ovum, Hystrichostrogylon membraniphorum, Odontochitina costata, Palaeohystrichophora infusorioides, Pterodinium cingulatum cingulatum, P.striatum (Clarke and Verdier) Yun, Rhiptocorys veligera, Senoniasphaera protrusa, S.rotundata, Spinidinium echinoideum, Spiniferites multibrevis, S.ramosus gracilis, S.ramosus granosus, S.ramosus ramosus, S.ramosus reticulatus, S.wetzellii, Surculosphaeridium? longifurcatum, Trichodinium castanea, Wallodinium anglicum.

Comments
This sample contains a number of forms which have their highest recorded occurrences in the Campanian; C.oceanica, F.ferox, H.ovum, P.striatum, S.protrusa, S.rotundata, S.echinoideum and T.castanea. In addition, two of these, P.striatum and S.protrusa first appear in the Santonian, thus suggesting a Santonian - Campanian age for this sample. Rich and diverse assemblage of dinoflagellate cysts; preservation is good - very good.

Sample locality 34 is near the O.pilula/Actinocamax quadrata boundary, which is used in the UK as the Lower/Middle Campanian boundary.

Sample WB/MBH 1.

FORAMINIFERA (MBH)
Arenobulimina courta, A.obliqua, A.pseudorbignyi Marie, Ataxophragmium variabile, Eggerellina brevis, Marssonella ellisorae Cushman, M.trochus, Orbignyna ovata von Hagenow, Tritaxia tricarinata, Cibicides beaumontianus, Eponides concinna Brotzen, Gavelinella cristata cristata, G.cristata brotzeni, G.eriksalensis, G.lorneiana, G.pertusa, G.stelligera, G.thalmanni, Globorotalites micheliniana, Gyroidinoides nitida, Praebulimina carseyae, Reussella kelleri Vasilenko, Stensioina granulata incondita Koch, Valvulineria lenticula, Archaeoglobigerina cretacea, Globigerinelloides aspera, Globotruncana bulloides, Heterohelix striata.

Comments
S.granulata incondita, R.kelleri, G.cristata brotzeni, and G.cristata cristata indicate a latest Early Campanian age. Very low percentage of planktonic taxa - but open shelf assemblage.

OSTRACODA (PPEW)
Bairdoppilata septentrionalis, Pontocyprella harrisiana.

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae, Tranolithus orionatus, Eprolithus floralis, Ellipsagelosphaera fossacincta, Retecapsa angustiforata, Calculites obscurus (common), Broinsonia parca, Broinsonia signata, Prediscosphaera cretacea, Microrhabdulus decoratus, Micula decussata, Cribrosphaerella ehrenbergii, Broinsonia enormis, Eiffellithus turriseiffelii, Eiffellithus eximius, Lithraphidites carniolensis, Retecapsa crenulata, Reinhardtites anthophorus,

Cyclagelosphaera margereli, Quadrum gartneri, Glaukolithus compactus, Helicolithus anceps, Kamptnerius magnificus, Braarudosphaera regularis, Tranolithus minimus, Gartnerago obliquum, Discorhabdus ignotus, Nannoconus truitti frequens.

Comments
Age diagnostic fossils - B.parca (Lower Campanian - Lower Maastrichtian), T.orionatus (Mid Albian - Lower Maastrichtian), E.floralis (Upper Aptian - Lower Campanian). Occassional W. barnesae coccospheres.

PALYNOMORPHS (BAT)
Dinoflagellate cysts: Cyclonephelium distinctum, Palaeohystrichopora infusoroides.

Comments
The two species present are long-ranging (Kimmeridgian - Maastrichtian and Albian - Campanian respectively) and are not, therefore, particularly significant stratigraphically. This preparation is virtually devoid of organic matter. Only one poorly-preserved specimen each of the above cysts was recorded.

Sample locality 35 is located within the top of the A.quadrata Zone, just below the junction with the overlying Belemnitella mucronata Zone.

Sample WB/MBH 6.

FORAMINIFERA (MBH)
Ammodiscus cretaceus, Arenobulimina courta, A.footei Jennings, A.obliqua, A.pseudorbignyi Marie, Ataxophragmium variabile, Gaudryina rugosa d'Orbigny, Marssonella trochus, Orbygnya ovata von Hagenow, Bolivinoides culverensis Barr, Cibicides beaumontianus, Gavelinella lorneiana, G.pertusa, G.usakensis, Globorotalites micheliniana, Gyroidinoides nitida, Loxostomum eleyi, Osangularia cordieriana, Praebulimina carseyae, P.reussi, Pullenia quaternaria, Stensioina granulata incondita Koch, S.pommerana Brotzen.

Comments
B.culverensis indicates a latest Middle Campanian age. Very low percentage of planktonic taxa - but open shelf environment.

OSTRACODA (PPEW)
Cardobairdia minuta, Cytherella ovata, Bairdoppilata septentrionalis, Cytherella cf. C. gruendeli Weaver, Cytherella cf. C. contracta Van Veen, Pontocyprella sp., Phacorhabdotus lonsdaleiana, Oertliella sp., Cythereis sp., Isocythereis ?sp.

CALCAREOUS NANNOFOSSILS (JAB)
Watznaueria barnesae, Prediscosphaera cretacea, Helicolithus anceps, Ellipsagelosphaera fossacincta, Calculites obscurus, Quadrum gartneri, Cribrosphaerella ehrenbergii, Lithraphidites carniolensis, Retecapsa angustiforata, Biscutum ellipticum, Eiffelithus turriseiffelii, Broinsonia parca, Reinhardtites anthophorus, Microrhabdulus decoratus, Braarudosphaera regularis, Retacapsa

crenulata, Micula decussata, Glaukolithus compactus, Tranolithus orionatus, Kamptnerius magnificus, Lucianorhabdus cayeuxii, Eiffelithus eximius, Broinsonia enormis, Lucianorhabdus maleformis, Ellipsagelosphaera ovata, Lucianorhabdus quadrifidus, Zeugrhabdotus embergeri, Lucianorhabdus arcuatus, Cretarhabdus striatus, Gartnerago obliquum, Rhagodiscus splendens, Nannoconnus elongatus, Arkhangelskiella cymbiformis, Nannoconnus truitti, Biscutum magnum, Calculites obscurus, Prediscosphaera grandis, ?Braarudosphaera turbinea.

Comments
Age diagnostic coccoliths include B.parca (Lower Campanian - Lower Maastrichtian), E.eximius (Mid-Turonian - Upper Campanian), L.grillii (Lower Santonian - Upper Campanian) and R.anthophorus (Lower Santonian - Upper Campanian).

PALYNOMORPHS (BAT)
Dinoflagellate cysts: Hystrichosphaeropsis ovum, Surculosphaeridium? longifurcatum.

Comments
The occurrence of H.ovum and S.?longifurcatum suggests a Coniacian - Campanian age for this sample.

Sample locality 36 lies within the B.mucronata Zone below the junction with the Reading Beds (see guide to the Palaeogene succession of Whitecliff Bay).

Sample WB/MBH.5

FORAMINIFERA (MBH)
Arenobulimina courta, A.footei, A.obliqua, Ataxophragmium variabile, Eggerellina brevis, Gaudryina rugosa, Marssonella ellisorae, M.trochus, Orbygnyna ovata, Bolivinoides decoratus, B.laevigatus, B.aculeata, Gavelinella lorneiana, G.pertusa, G.thalmanni, G.trochus, G.usakensis, Globoratalites micheliniana, Gyroidinoides nitida, Loxostomum eleyi, Osangularia cordieriana, Praebulimina carseyae, Stensioina pommerana, Valvulineria lenticula, Archaeglobigerina cretacea.

Comments
B.decoratus and B.laevigatus indicate an early Late Campanian age. Very low percentage of planktonic taxa but open shelf environment.

OSTRACODA (PPEW)
Cytherella sp., Cardobairdia minuta, Cytheropteron sp.

Comments
Poor fauna, numbers restricted due to difficulty of extraction.

CALCAREOUS NANNOFOSSILS (JAB)
Micula decussata, Calculites obscurus, Eiffelithus eximius, Watznaueria barnsae, Gartnerago obliquum, Ellipsagelosphaera fossacincta, Prediscosphaera cretacea, Glaukolithus compactus,

Eiffelithus turriseiffelii, Rhagodiscus asper, Biscutum ellipticum, Braarudosphaera regularis, Helicolithus anceps, Quadrum gartneri, Glaukolithus diplogrammus, Reinhardtites anthophorus, Arkhangelskiella cymbiformis, Manivitella pemmatoidea, Kamptnerius magnificus, Microrhabdulus decoratus, Retacapsa angustiforata, R.crenulata, Cribrosphaerella ehrenbergii, Rhagodiscus splendens, Helicolithus trabeculatus, Broinsonia parca, Lithraphidites carniolensis, Prediscosphaera spinosa, P.grandis, Broinsonia enormis, Discorhabdus ignotus, Biscutum magnum.

Comments
Age diagnostic forms include B.parca (Lower Campanian - Lower Maastrichtian), R.anthophorus (Lower Santonian - Upper Campanian), E.eximius (Mid Turonian - Upper Campanian).

PALYNOMORPHS (BAT)
Dinoflagellate cysts: Odontochitina costata, Palaeohystrichophora infusorioides, Spiniferites ramosus ramosus.

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PALAEOGENE

J.W. Murray, J.E. Robinson, L.T. Gallagher, G.L. Eaton, B.A. Tocher.

The stratigraphic nomenclature of the Palaeogene has evolved over a period of more than 150 years. In 1978, Curry et al. reviewed and summarised the current state of knowledge. Since then changes have been proposed for the Early Eocene (King 1981), the Early to Late Eocene (Edwards and Freshney 1987), and the Late Eocene and Early Oligocene (Insole and Daley 1985).

New data on calcareous nannofossils (Aubry 1983, 1986) are in general agreement with the summary of Curry et al. (1978). However, the revised geochronometric scale of Berggren et al. (1985) shows marked differences with that of Hardenbol and Berggren (1978) and that of Odin et al. (1978). A magnetostratigraphy study (Townsend and Hailwood 1985); Aubry et al. 1986) has suggested a break of ~2ma in the Wittering Formation (possible absence of anomaly 22). The current nomenclature is summarised in Fig. 15.

Source references for microfossils

Foraminifera: Curry 1937, 1966; Murray and Wright 1974; King 1981; Murray et al. 1981.

Ostracods: Haskins 1968-71, 1971; Keen 1968, 1971, 1972a, b, 1975, 1977, 1978.

Calcareous nannoplankton: Martini 1971; Hamilton and Hojjatzadeh 1982; Aubry 1983, 1986.

Microplankton: Davey et al. 1966; Eaton 1976; Costa and Downie 1976; Costa et al. 1976; Bujak et al. 1980; Liengjarern et al. 1980.

Charophytes: Reid and Groves 1921; Groves 1926; Curry 1966; Feist-Castel 1977.

Reference samples

A suite of samples collected by J.W. Murray was studied by all contributors (see Table 1).

Table 1. Details of sample locality numbers used in this guide and sample numbers of the reference samples. Splits were labelled F = foraminifera, osracods; M = microplankton and N = nannoplankton. Barren samples underlined. (Loc. = Locality; PSN = Palaeogene Sample No.)

Loc.	PSN				Loc.	PSN				Loc.	PSN				Loc.	PSN			
I 37	2	F	M		I 44	9	F	M	N	I 51	17	F	M		I 58	30	F	M	N
I 38	3	F	M		I 45	10		M		I 52	18	F	M		I 59	29	F	M	N
I 39	4	F	M		I 46	11	F	M	N	I 53	19		M		I 60	28	F	M	N
I 40	5		M		I 47	12	F	M		I 54	20		M		I 61	27	F	M	N
I 41	6	F	M	N	I 48	14	F			I 55	21		M		I 62	24	F	M	
I 42	7			N	I 49	15	F	M	N	I 56	22		M		I 63	23	F		
I 43	8	F	M	N	I 50	16	F	M		I 57	31	F	M	N	I 64	32	F	M	

Fig. 15. Stratigraphic summary. Epochs: oblique shading indicates uncertainty in placing the boundary. Thames Valley: Thanet and Reading Formations after Curry et al. (1978), Thames Group after King (1981). Isle of Wight: Reading Formation after Knox (1984), London Clay Formation, Bracklesham Group and Barton Group after Edwards and Freshney (1987) plus London Clay Formation Divisions A-D from King (1981). Solent Group after Curry et al. (1978) and Insole and Daley (1985); Bbm = Basement Bed Member. I-XIX, bed numbers after Fisher (1862). Calcareous nannoplankton (n) after Aubry (1986); nl = occurrence at Lower Swanwick. Magnetostratigraphy after Townsend and Hailwood (1985) and Aubry et al. (1986); normal phases numbered C20-C26, Oe = Oldhaven event, normal event C22 missing and its probable position shown by a dotted rectangle. Vertical ornament indicates a gap in the sedimentary record. Approximate positions of the Paris and Belgian Basin "stages" are given to assist the interpretation of European range data.

EPOCH		Odin et al., 1982	Curry & Odin, 1982	Harland et al., 1982	Berggren et al., 1985	NP Nannofossil Zones	THAMES VALLEY	ISLE OF WIGHT WEST Alum Bay, Headon Hill, Hamstead	ISLE OF WIGHT EAST Whitecliff Bay	PARIS BASIN 'Stages'	BELGIAN BASIN 'Stages'
OLIGOCENE	Late	23	23	24.6	23.7	25					
		26	27	32.8	30	24				Stampian	Rupelian
	Eorly					23					
		31				22				Sannoisian	Tongrian
		32.5	34	38	36.6	21					
						20				Ludian	
EOCENE	Late					19					
				42	40	18					
						17				Marinesian	Asschian
			39			16					
		41								Auversian	Wemmelian
	Mid					15				Lutetian	Ledion
						14					Bruxellian
		44.5	45	50.5	52	13					Paniselian
	Early					12					Ypresian
						11					
						10					
		51	53	54.9	57.8	9				Sparnocion	Landenian
PALAEOCENE	Lote					8					
		56				7					Heersian
						6					

Alum Bay, Headon Hill, Hamstead:
- Solent Group: Bouldnor Fm.; Bembridge Lst. Fm.; Heodon Hill Fm.
- Borton Group: Bectan Sand Fm.; Chama Sand Fm.; Barton Clay Fm. C20
- Brockleshom Group: 'Bagshot Sands'; C21; C22; C23
- Thomes Group: London Clay Fm. E D C B A Bbm; C24.1 C24.2; oe; Reading Fm.; C25; n; Thanet Fm.; C26

Whitecliff Bay:
- Solent Group: Bouldnor Fm.; Bembridge Lst. Fm.; Headon Hill Fm.
- Borton Group: Bectan Sand Fm.; Chama Sand Fm.; Barton Cloy Fm. XIX XVIII; Selsey Sand Fm. IX–XVII; Marsh Farm Fm. VIII; Earnley Sand Fm. VII VI; Wittering Fm. V
- Brockleshom Group: C21; C22; Wittering Fm. C23 IV III; C24.1 C D; London Clay Fm. C24.2 B A Bbm; oe; Reading Fm.

General comments

Dinoflagellates (G.L. Eaton and B.A. Tocher)

Tertiary marine sands and clays from coastal sections on the Isle of Wight can potentially yield rich and diverse palynological assemblages of organic-walled microplankton, pollen and spores. In the succeeding listings for 24 palynologically productive samples from Eocene and Oligocene horizons, emphasis is placed on one particular group of the organic-walled microplankton - the dinoflagellate cysts. This algal group displays great morphological diversity in the Tertiary period, and especially in Eocene sediments. In the studied samples, the indigenous cyst floras are frequently accompanied by other algal palynomorphs includingspinose acritarchs, leiospheres, the problematic form Paralaceniella indentata (Deflandre and Cookson), examples of the freshwater colonial form, Pediastrum Meyen, as well as reworked dinoflagellate cysts from older (Cretaceous and Jurassic) sediments.

Dinoflagellate cyst assemblage quality and diversity vary rapidly over very short stratigraphic intervals in these Tertiary sediments. This point should be borne in mind when attempting to re-sample, and in comparing the species lists in this study with those for "equivalent" horizons in Davey et al. (1966), Eaton (1976), Bujak et al.(1980) and Liengjarernet al. (1980).

Nannofossils (L.T. Gallagher)

Knowledge of the calcareous nannofossil content of Palaeogene Formations of northwest Europe is now quite well advanced. Pioneer work within the Anglo-Paris Basins was carried out by Bramlette and Sullivan (1961), Hay and Mohler (1967), and Hodson and West (1975). In 1971 Martini used localities in southern England as reference sites for his Standard

Tertiary Zonation Scheme and more recently Hamilton and Hojjatzadeh (1982) and Aubry (1983, 1986) have made detailed studies of Palaeogene sections from the classic northwest European sites. The type localities of the THANET FORMATION (THANETIAN, LATE PALAEOCENE) have recently been re-ivestigated in terms of naanofossil biostratigraphy by Siesser, Ward and Lord (1987).

The samples analysed for this study have yielded assemblages of calcareous nannofossils which show close similarity with those reported by Aubry (1986) and correlate reasonably well with assemblages from other northwest European basins and with those found in the southern and central North Sea.

The number of barren intervals interspersed with the levels in which calcareous nannofossils were recovered indicates that the Hampshire Basin was probably of a marginal marine disposition and its high latitude location and localised calcareous nannofossil content may well merit the erection of a regional biozonation scheme.

The oldest beds which contain calcareous nannofossils are of an age equivalent to Martini's NP12 zone (= Early Eocene) based on the first occurrences of Discoaster kuepperi (as a replacement for the rare or absent D.lodensis, Aubry 1986). The best preserved assemblage of this age was recovered from the Fisher Bed IV at Bracklesham, where species of Toweius, Sphenolithus and Discoaster occur in a moderately diverse association.

By far the most abundant and diverse assemblages occur in beds dated as (equivalent) NP15/16 (Middle Eocene). Fisher Bed XV at Bracklesham is

particularly interesting for its association of Pemma and Nannotetrina species, probably reflecting a near shore environment.

A slightly younger Middle Eocene age is suggested for the samples from the Barton Clay Formation based on the first occurrence of Reticulofenestra reticulata.

Whitecliff Bay SZ 640860 (Fig. 16)

Resting unconformably on Upper Chalk of the Late Cretaceous, there is an almost continuously exposed succession of Palaeogene strata. For this reason, it has been selected as the stratotype for a number of lithostratigraphic units:

London Clay Formation - hypostratotype (King 1981) emended by Edwards and Freshney (1987)

Bracklesham Group - stratotype (Curry et al. 1977)

Wittering Formation - stratotype (Edwards and Freshney 1987)

Earnley Sand Formation - stratotype (King and King 1977; Edwards and Freshney 1987)

Marsh Farm Formation - stratotype (Edwards and Freshney 1987)

Selsey Sand Formation - stratotype (Edwards and Freshney 1987)

Solent Group - stratotype (Insole and Daley 1985)

Bembridge Limestone Formation - stratotype (Insole and Daley 1985)

The Palaeogene succession was deposited in environments varying from continental to shallow marine. The frequent facies changes throughout the succession cause lateral variation in lithology. The cliffs are actively being eroded and consequently the cliff line at present lies some tens of metres landwards of that measured in detail by Prestwich (1846,

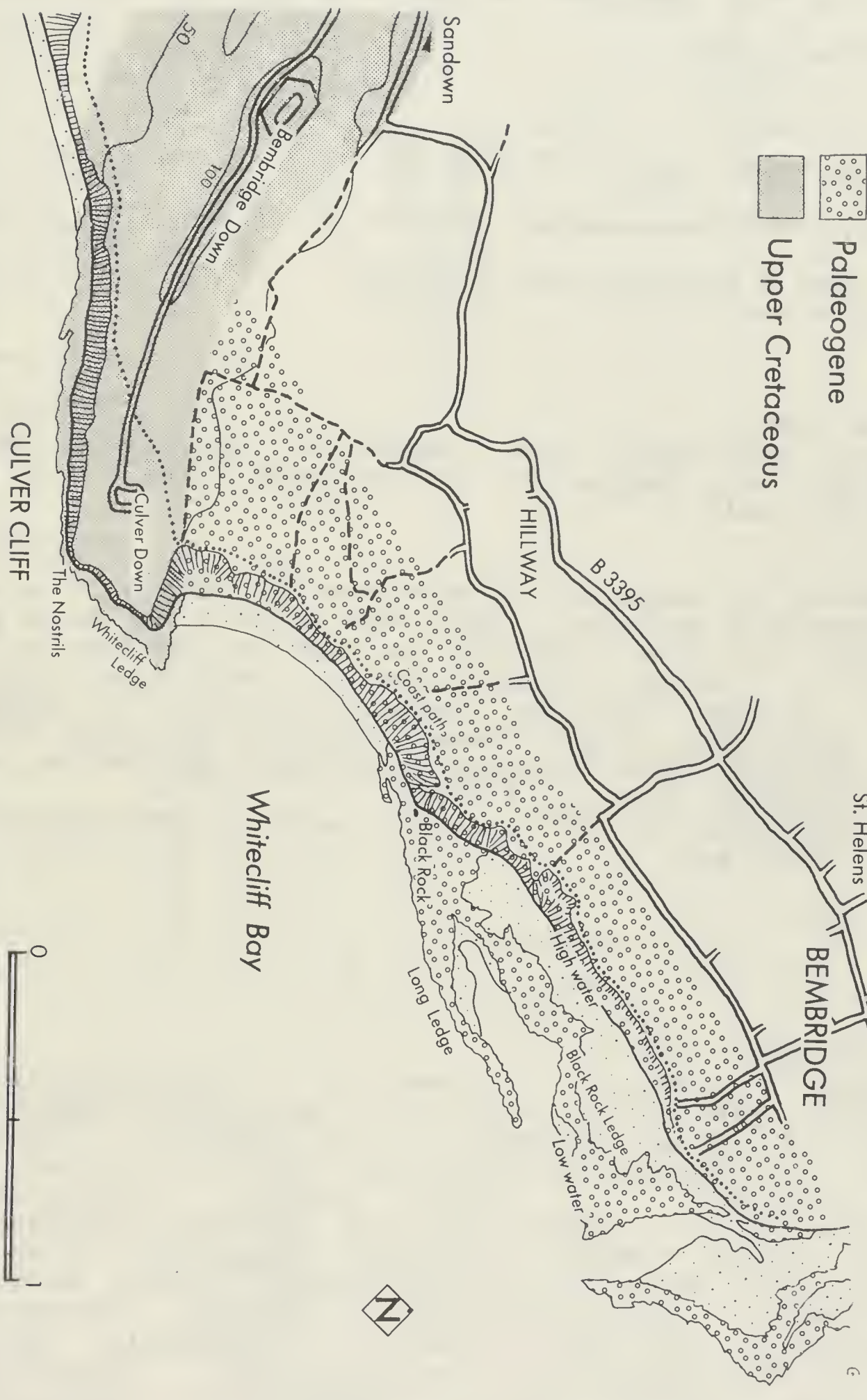


Fig. 16. Map of Whitecliff Bay.

1847) and Fisher (1862). Fig. 17 shows a sketch section drawn in 1985-1986. In the London Clay Fm. A2 to D represent the divisions of King (1981) while the roman numerals of the Bracklesham Group represent the bed numbers of Fisher (1862).

Whitecliff Bay, sample locality I37 (Fig. 18)

Early Eocene, London Clay Formation, division A3 of King (1981, p.76), 14.3m above base of formation. Brown silty clay.

Sample 2F

FORAMINIFERA (JWM)
An entirely agglutinated fauna composed of: Ammobaculites spp., Cribrostomoides spp., Reophax spp. and Saccammina sp. Small valves of Lingula sp. are present.

Comments
This assemblage is interpreted as the residue from the decalcification through weathering of the mudrock. Sample W11 collected by Murray and Wright (1974, p.12) from essentially the same level but from freshly exposed cliff, yielded a fauna composed of:*Bolvinopsis adamsi (Lalicker), Cibicides cunobelini Haynes,*Cibicides cf. C. pygmeus (Hantken), Cibicidoides alleni (Plummer),*Elphidium hiltermanni Hagn, Epistominella vitrea Parker,*Gyroidina angustiumbilicata Ten Dam, and *Pullenia quinqueloba (Reuss). (* rare).
This was interpreted as representing a deltaic marine, slightly hyposaline environment, 10-60m deep.

OSTRACODA (ER)
Barren

Sample 2m

DINOFLAGELLATE CYSTS (GLE)
Achomosphaera alcicornu (Eisenack), Amphorosphaeridium? multispinosum (Davey and Williams), Apectodinium homomorphum (Deflandre and Cookson), Areoligera cf. A. senonensis Lejeune-Carpentier, Cordosphaeridium exilimurum Davey and Williams, C. gracile (Eisenack), C. inodes (Klumpp), Cribroperidinum tenuitabulatum (Gerlach), Diphyes colligerum (Deflandre and Cookson), Dracodinium solidum Gocht, Deflandrea phosphoritica Eisenack, Fibrocysta radiata (Morgenroth), Hystrichokolpoma rigaudiae Deflandre and Cookson, Hystrichosphaeridium tubiferum (Ehrenburg), Impletosphaeridium implicatum Morgenroth, Lejeunecysta hyalina (Gerlach), Melitasphaeridium pseudorecurvatum (Morgenroth), Oligosphaeridium complex (White), Operculodinium centrocarpum (Deflandre and Cookson), Operculodinium divergens (Davey and Williams), Spiniferites ramosus group and Systematophora placacantha (Deflandre and Cookson).

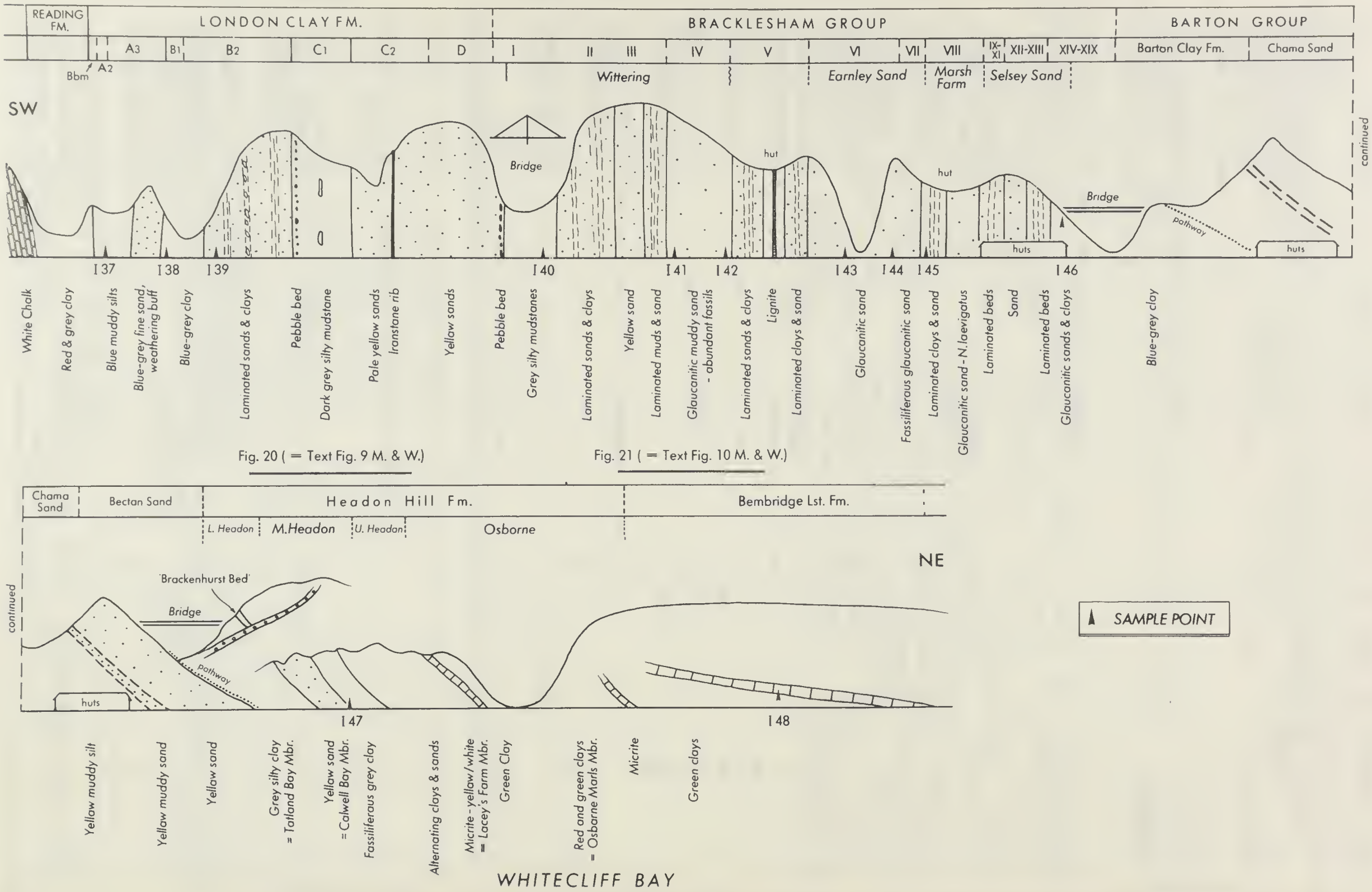


Fig. 17. Sketch section of Whitecliff Bay.
"M. & W." = Murray and Wright (1974).

Reworked Cretaceous taxa:
Chlamydophorella sp., Cribroperidinium sp., Exochosphaeridium sp. and Pseudoceratium pelliferum Gocht.

Reworked Jurassic taxa:
Criboperidinium sp., Gonyaulacysta jurassica (Deflandre), Hystrichogonyaulax cladophora (Deflandre), Nannoceratopsis pellucida Deflandre, Pareodinia ceratophora Deflandre, Sentusidinium rioultii (Sarjeant) and Tubotuberella sp.

Comments
The appearance of D.phosphoritica and H.rigaudiae indicates biozone LC-1 of Bujak et al. (1980).

Whitecliff Bay, sample locality I38 (Fig. 18)

Early Eocene, London Clay Formation, Division B2 of King (1981, p.76), at the southern margin of a large landslip. Brown silty clay with Panopaea.

Sample 3F

FORAMINIFERA (JWM)
Fauna sparse due to current weathering of section.

OSTRACODA (ER)
Barren

Sample 3M

DINOFLAGELLATE CYSTS (GLE)
Apectodinium homomorphum, (Deflandre and Cookson), Cordosphaeridium gracile, (Eisenack), C.inodes (Klumpp), Cribroperidinium tenuitabulatum (Gerlach), Deflandrea oebisfeldensis Alberti, Diphyes colligerum (Deflandre and Cookson), Glaphyrocysta divaricata (Williams and Downie), G.ordinata (Williams and Downie), Glaphyrocysta pastielsii (Deflandre and Cookson), Hystrichokolpoma rigaudiae Deflandre and Cookson, Hystrichosphaeridium salpingophorum Deflandre, Hystrichosphaeridium tubiferum (Ehrenberg), Lingulodinium machaerophorum (Deflandre and Cookson). Oligosphaeridium complex (White), Operculodinium centrocarpum (Deflandre and Cookson), Operculodinium divergens (Davey and Williams), Palaeocystodinium golzowense Alberti, Spiniferites ramosus group and Thalassiphora delicata Williams and Downie.

Reworked Cretaceous taxa
Dinodinium albertii Sarjeant, Hystrichodinium voigtii (Alberti), and Pseudoceratium pelliferum Gocht.

Reworked Jurassic taxa
Ctenidodinium sp.,Gonyaulacysta jurassica (Deflandre), Hystrichogonyaulax cladophora (Deflandre), Kalyptea sp., Nannoceratopsis gracilis Alberti and Pareodinia ceratophora Deflandre.

Comments
The occurrence of D.oebisfeldensis indicates an age no younger than

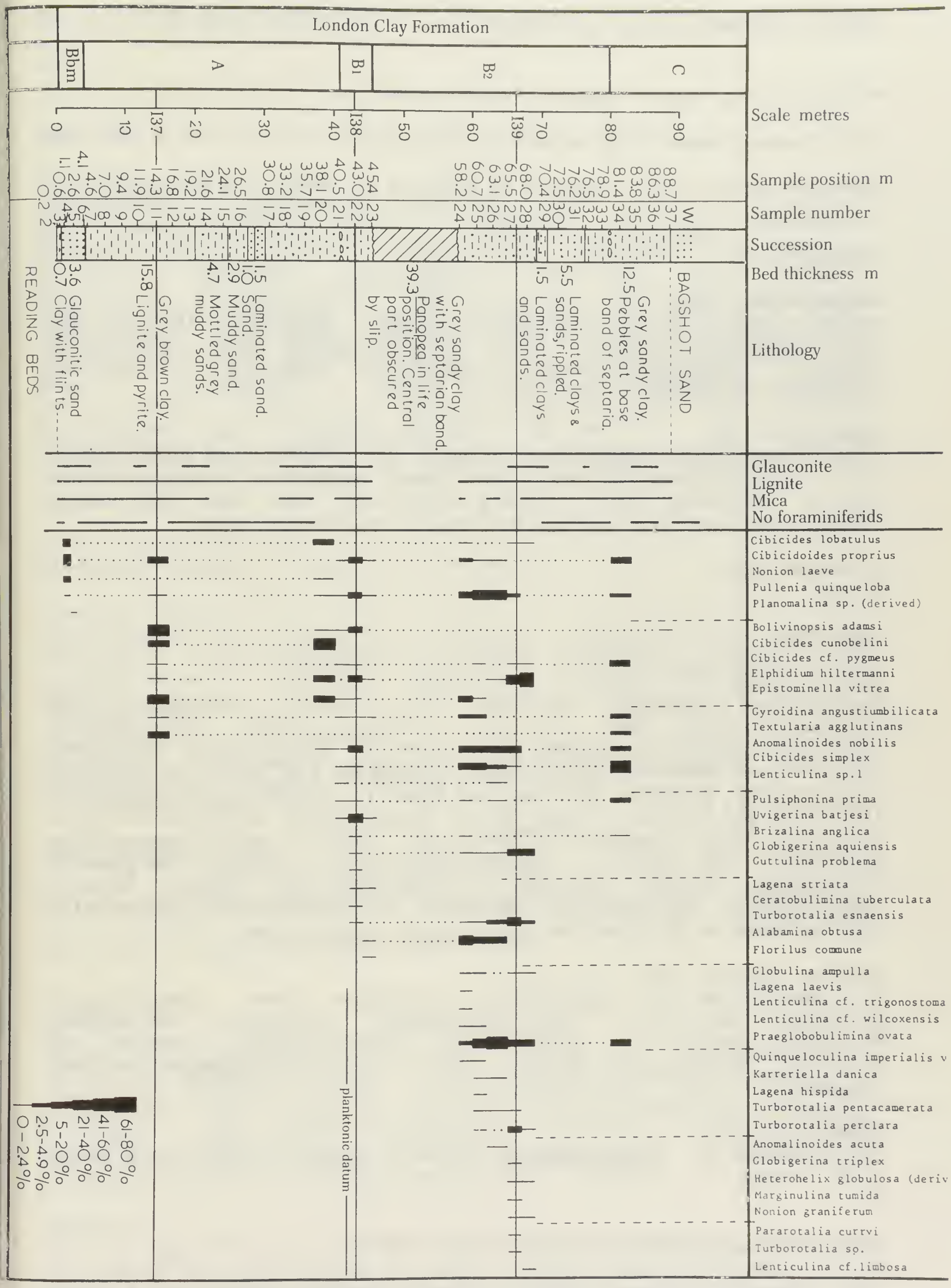


Fig. 18. Text-fig. 5 of Murray and Wright (1974).

biozone LC-3 of Bujak et al. (1980).

Whitecliff Bay, sample locality I39 (Fig. 18)

Early Eocene, London Clay Formation, Division B2 of King (1981, p.76), 11m below the pebble bed at the base of Division C1. Hard silty blue clay.

Sample 4F

FORAMINIFERA (JWM)
*Anomalinoides nobilis (Brotzen),*Cibicides lobatulus (Walker and Jacob), Elphidium hiltermani Hagn, Praeglobolimina ovata (d'Orbigny), Pullenia quinqueloba (Reuss), Turborotalia esnaensis (Le Roy) and reworked Cretaceous heterohelicids. (* rare).

Comments
This is approximately equivalent to sample W27 of Murray and Wright (1974, p.12) which yielded a more diverse fauna interpreted as representing a shallow, nearshore shelf, slightly hyposaline, 0-20m deep but having communication with the open sea (presence of planktonic forms).

OSTRACODA (ER)
Barren

Sample 4M

DINOFLAGELLATE CYSTS (GLE)
Apectodinium homomorphum (Deflandre and Cookson), Cordosphaeridium exilimurum Davey and Williams, Cribroperidinium tenuitabulatum (Gerlach), Deflandrea phosphoritica Eisenack, Glaphyrocysta divaricata (Williams and Downie), Glaphyrocysta exuberans (Deflandre and Cookson), Glaphyrocysta ordinata (Williams and Downie), Glaphyrocysta pastielsii (Deflandre and Cookson), Homotryblium tenuispinosum Davey and Williams, Hystrichokolpoma rigaudiae Deflandre and Cookson, Hystrichosphaeridium tubiferum (Ehrenberg), Lanternosphaeridium lanosum Morgenroth, Lejeunecysta hyalina (Gerlach), Oligosphaeridium complex (White), Operculodinium centrocarpum (Deflandre and Cookson), Polysphaeridium subtile Davey and Williams and Spiniferites ramosus group.

Reworked Jurassic taxa
Cribroperidinium sp., Ctenidodinium continuum Gocht, Gonyaulacysta jurassica (Deflandre), Hystrichogonyaulax cladophora (Deflandre), Paragonyaulacysta sp., Scriniodinium parvimarginatum (Cookson and Eisenack), Sirmiodinium grossii Alberti and Systematophora areolata Klement.

Comments
The occurrence of H.tenuispinosum indicates biozone LC-2/LC-3 of Bujak et al. (1980).

Whitecliff Bay, sample locality I40 (fig. 19)

Early Eocene, Bracklesham Group, Wittering Formation, Fisher Bed I (Eaton

Bed 1), 12.2m above pebble bed at base of group. Green glauconitic muddy sand.

Sample 5M

DINOFLAGELLATE CYSTS (GLE)
Apectodinium homomorphum (Deflandre and Cookson), Areoligera cf. A.medusettiformis (Wetzel), Ceratiopsis depressa (Morgenroth), Cordosphaeridium gracile (Eisenack), Deflandrea phosphoritica Eisenack, Diphyes colligerum (Deflandre and Cookson), Dracodinium varielongitudum (Williams and Downie), Glaphyrocysta ordinata (Williams and Downie), Homotryblium abbreviatum Eaton, Homotryblium tenuispinosum Davey and Williams, Hystrichokolpoma rigaudiae Deflandre and Cookson, Kisselovia coleothrypta (Williams and Downie), Lejeunecysta hyalina (Gerlach), Lentinia wetzelii (Morgenroth), Lingulodinium machaerophorum (Deflandre and Cookson), Melitasphaeridium pseudorecurvatum (Morgenroth), Operculodinium centrocarpum (Deflandre and Cookson), Phthanoperidinium echinatum Eaton, Spiniferites ramosus group and Thalassiphora pelagica Williams and Downie.

Reworked Cretaceous taxa
Palaeohystrichophora infusorioides Deflandre

Reworked Jurassic taxa
Cribroperidinium? longicorne (Downie), Gonyaulacysta jurassica (Deflandre), Hystrichogonyaulax cladophora (Deflandre), Nannoceratopsis gracilis Alberti, Pareodinia ceratophora Deflandre and Sentusidinium rioultii Sarjeant.

Comments
H.abbreviatum and P.echinatum make their first appearance in biozone B-1 (Bujak et al. 1980).

Whitecliff Bay, sample locality I41 (fig. 19)

Early Eocene, Bracklesham Group, Wittering Formation, Fisher Bed IV, 1m above base of bed. NP12 (Aubry 1986, p.293).

Sample 6F

FORAMINIFERA (JWM)
*Brizalina anglica Cushman, Cibicides tenellus (Reuss), Elphidium hiltermanni Hagn, Globulina ampulla (Jones), Globulina irregularis d'Orbigny, Guembelitria triseriata (Terquem), Lagena striata (d'Orbigny), Nonion laeve (d'Orbigny),*Nonionella sp., Nummulites planulatus (Lamarck) and Quinqueloculina sp. (* rare).

Comments
This is equivalent to sample W52 of Murray and Wright (1974, p.16) interpreted as representing a lower estuary, depth <10m and salinity 20-30 % . The nummulites were thought probably to be transported in. Wrigley and Davis (1973) interpret the macrofauna as littoral.

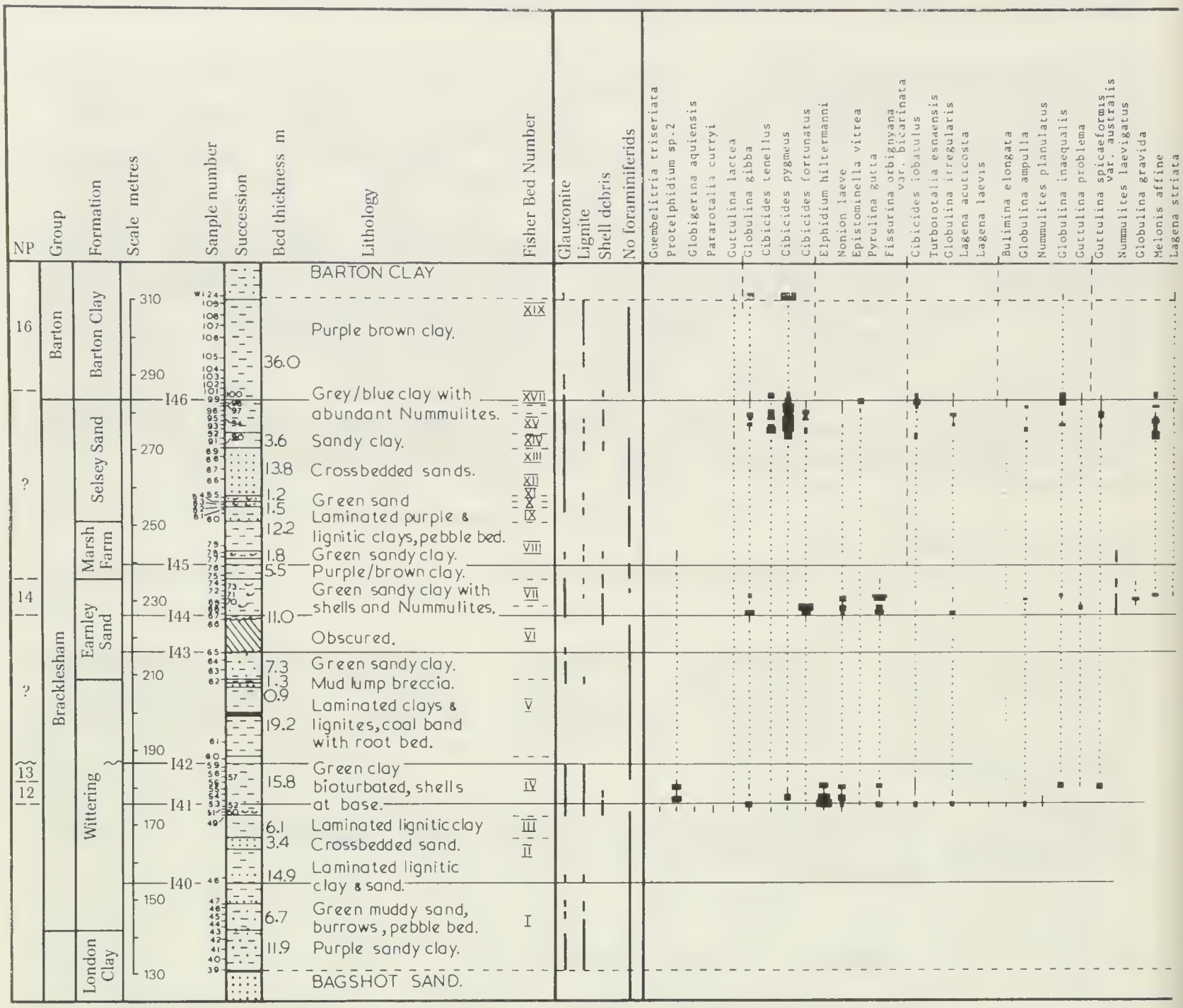
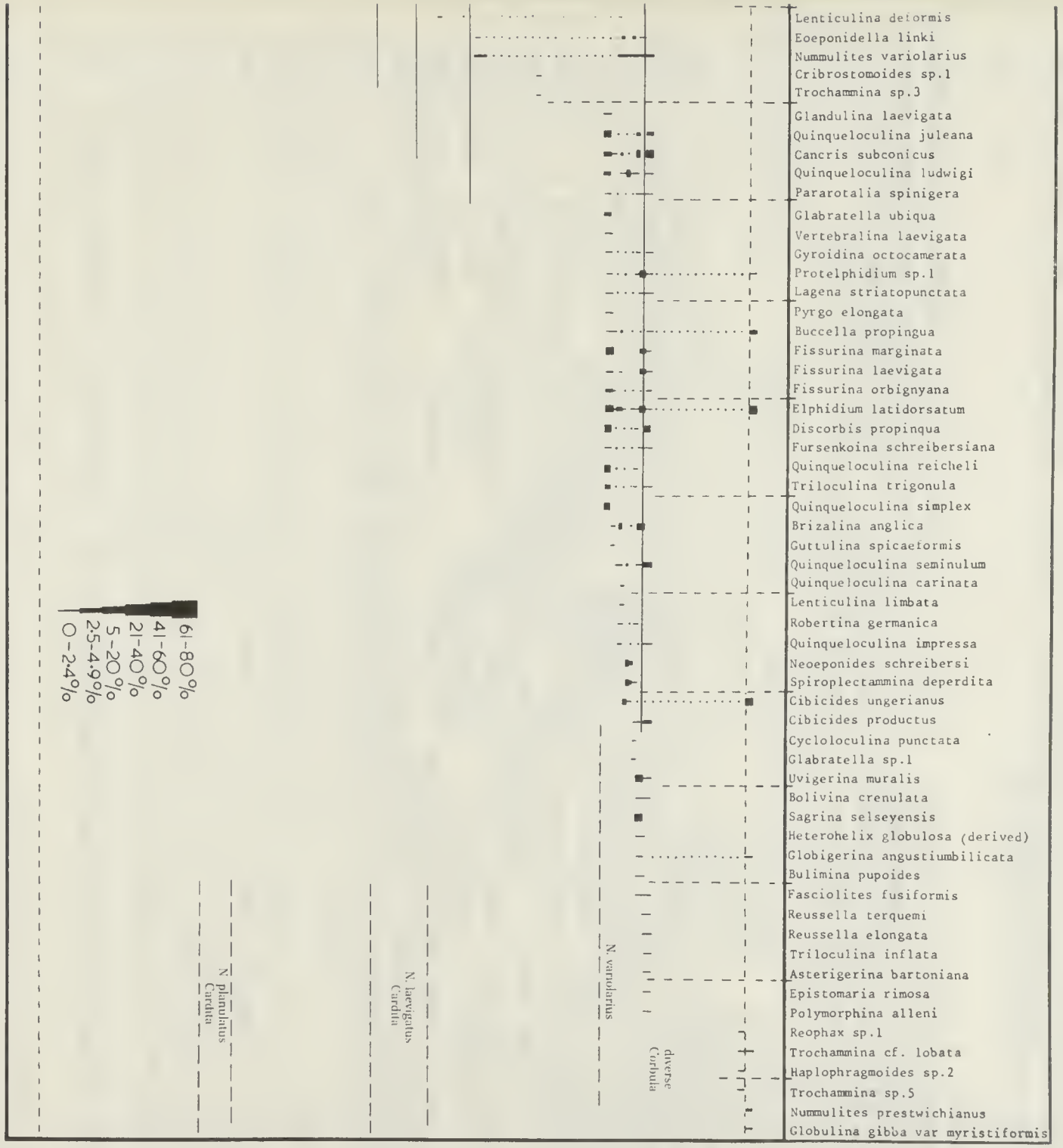


Fig. 19. Text-fig. 7 of Murray and Wright (1974).


61-80%
41-60%
21-40%
5-20%
2·5-4·9%
0-2·4%
N. planulatus Cardita
N. laevigatus Cardita
N. variolarius
diverse Cardita
Lenticulina deformis
Eoeponidella linki
Nummulites variolarius
Cribrostomoides sp.1
Trochammina sp.3
Glandulina laevigata
Quinqueloculina juleana
Cancris subconicus
Quinqueloculina ludwigi
Pararotalia spinigera
Glabratella ubiqua
Vertebralina laevigata
Gyroidina octocamerata
Protelphidium sp.1
Lagena striatopunctata
Pyrgo elongata
Buccella propingua
Fissurina marginata
Fissurina laevigata
Fissurina orbignyana
Elphidium latidorsatum
Discorbis propinqua
Fursenkoina schreibersiana
Quinqueloculina reicheli
Triloculina trigonula
Quinqueloculina simplex
Brizalina anglica
Guttulina spicaeformis
Quinqueloculina seminulum
Quinqueloculina carinata
Lenticulina limbata
Robertina germanica
Quinqueloculina impressa
Neoeponides schreibersi
Spiroplectammina deperdita
Cibicides ungerianus
Cibicides productus
Cycloloculina punctata
Glabratella sp.1
Uvigerina muralis
Bolivina crenulata
Sagrina selseyensis
Heterohelix globulosa (derived)
Globigerina angustiumbilicata
Bulimina pupoides
Fasciolites fusiformis
Reussella terquemi
Reussella elongata
Triloculina inflata
Asterigerina bartoniana
Epistomaria rimosa
Polymorphina alleni
Reophax sp.1
Trochammina cf. lobata
Haplophragmoides sp.2
Trochammina sp.5
Nummulites prestwichianus
Globulina gibba var myristiformis

OSTRACODA (ER)
Cytheridea primitia Haskins, Cytheridia rigida punctata Haskins, Echinocythereis scabropapulosa (Jones), Eocytheropteron grekoffi Margerie, Leguminocythereis bullata Haskins, Novocypris whitecliffensis Haskins and Schizocythere sp.

Comments
N.whitecliffensis appears first in upper P8 (Upper Ypresian), L.bullata has a range within the Cuisian and C.rigida punctata has a range Cuisian to Lutetian (Keen, 1978). The assemblage represents a polyhaline marine offshore facies (= assemblage V of Keen, 1977).

Sample 6M

DINOFLAGELLATE CYSTS (GLE)
Apectodinium homomorphum (Deflandre and Cookson), Areoligera cf. A. senonensis Lejeune Carpentier, Cordosphaeridium fibrospinosum Davey and Williams, Cordosphaeridium gracile (Eisenack), Cribroperidinium tenuitabulatum (Gerlach), Deflandrea phosphoritica Eisenack, Diphyes colligerum (Deflandre and Cookson), Glaphyrocysta divaricata (Williams and Downie), Homotryblium abbreviatum Eaton, Homotryblium tenuitabulatum Davey and Williams, Hystrichokolpoma rigaudiae Deflandre and Cookson, Kisselovia coleothrypta (Williams and Downie), Lingulodinium machaerophorum (Deflandre and Cookson), Phthanoperidinium echinatum Eaton, Polysphaeridium subtile Davey and Williams, Spiniferites ramosus group and Thalassiphora pelagica (Eisenack).

Comments
No significant forms for biohorizons in Bujak et al. (1980). The sample horizon is equivalent to W18 in Eaton (1976).

Whitecliff Bay, sample locality I42 (fig. 19)

Early Eocene, Bracklesham Group, Wittering Formation, Fisher Bed IV, 1m from top. Blue sandy clay.

Sample 7N

CALCAREOUS NANNOFOSSILS (LTG)
Campylosphaera dela (Bramlette and Sullivan) Hay and Mohler, Coccolithus pelagicus (Wallich) Schiller, Discoaster binodosus Martini, Discoaster distinctus Martini, Discoaster keupperi Stradner, Sphenolithus radians Deflandre, Sphenolithus sp., Reticulofenestra minuta Roth, Toweius occultatus (Locker) Perch-Nielsen and Transversopontis pulchra (Deflandre) Romein, 1977.

Comments
Preservation quite good, abundance and diversity very low. Age equivalent NP12 of Martini (1971) based upon the first occurrence of D.keupperi (as a replacement for the rare or absent D.lodensis used by Aubry (1986).

Whitecliff Bay, sample locality I43 (fig. 19)

Middle Eocene, Bracklesham Group, Earnley Formation, Fisher Bed IV (Eaton Bed 10a). Blue sandy clay.

Sample 8M

DINOFLAGELLATE CYSTS (GLE)
Achilleodinium biformoides (Eisenack), Achomosphaera alcicornu (Eisenack), Apectodinium homomorphum (Deflandre and Cookson), Areoligera sentosa Eaton, Areosphaeridium diktyoplokus (Klumpp), Cordosphaeridium gracile (Eisenack), Cordosphaeridium inodes (Klumpp), Cribroperidinium tenuitabulatum (Gerlach), Diphyes colligerum (Deflandre and Cookson), Eocladopyxis peniculata Morgenroth, Glaphyrocysta exuberans (Deflandre and Cookson), Homotryblium caliculum Bujak, Homotryblium tenuispinosum Davey and Williams, Hystrichokolpoma granulata Eaton, Hystrichokolpoma rigaudiae Deflandre and Cookson, Hystrichokolpoma salacium Eaton, Impletosphaeridium cracens Eaton, Impletosphaeridium rugosum Morgenroth, Lentinia wetzelii (Morgenroth), Lingulodinium machaerophorum (Deflandre and Cookson), Operculodinium centrocarpum (Deflandre and Cookson), Palaeocystodinium golzowense Alberti, Paucisphaeridium inversibuccinum (Davey and Williams), Pentadinium laticinctum Gerlach, Phthanoperidinium echinatum Eaton, Phthanoperidinium comatum (Morgenroth), Polysphaeridium subtile Davey and Williams, Spiniferites pseudofurcatus (Klumpp), Spiniferites ramosus group, Systematophora placacantha (Deflandre and Cookson), Thalassiphora pelagica (Eisenack), Wetzeliella articulata Eisenack and Wetzeliella spp.

Comments
The first occurrence of A.sentosa, I.cracens and P.comatum with H.granulata is indicative of biozone B-3 (Bujak et al. 1980). The sample is equivalent to W32, Eaton (1976).

Whitecliff Bay, sample locality I44 (fig. 19)

Middle Eocene, Bracklesham Group, Earnley Formation, Fisher Bed VI, 24m above lignitic top of Bed V. Fossiliferous blue sandy clay.

Sample 9F

FORAMINIFERA (JWM)
Anomalinoides nobilis Brotzen, Globulina ampulla (Jones), Nonion laeve (d'Orbigny), Nummulites laevigatus (Bruguiere) and Pyrulina gutta d'Orbigny.

Comments
Equivalent to sample W67 of Murray and Wright (1974, p.16) interpreted as representing a nearshore shelf, depth <50m, slightly hyposaline.

OSTRACODA (ER)
Cytheretta aff.C.aticosta Reuss, Cytheridea primitia Haskins, Cytheridea rigida punctata Haskins and Eopaijenborchella longicosta

Keij.

Comments
C.rigida punctata (Cuisian - Lutetian), C.primitia (Middle Ypresian - Lutetian)(Keen, 1978). Assembage V of Keen (1978) representing the inshore zone of a polyhaline marine environment.

Sample 9M

DINOFLAGELLATE CYSTS (GLE)
Achilleodinium biformoides (Eisenack), Amphorosphaeridium? multispinosum (Davey and Williams), Cordosphaeridium gracile (Eisenack), Cordosphaeridium inodes (Klumpp), Diphyes colligerum (Deflandre and Cookson), Glaphyrocysta exuberans (Deflandre and Cookson), Impletosphaeridium rugosum Morgenroth, Kisselovia tenuivirgula (Williams and Downie), Lentinia wetzelii (Morgenroth), Lingulodinium machaerophorum (Deflandre and Cookson), Operculodinium centrocarpum (Deflandre and Cookson), Phthanoperidinium echinatum Eaton, Spiniferites ramosus group, Systematophora placacantha (Deflandre and Cookson) and Wetzeliella spp.

Comments
Equivalent to sample W36 of Eaton (1976).

Sample 9N

CALCAREOUS NANNOFOSSILS (LTG)
Blackites spinosus (Deflandre) Hay and Towe, Chiasmolithus bidens (Bramlette and Sullivan) Hay and Mohler, Coccolithus pelagicus (Wallich) Schiller, Cruciplacolithus tenuis (Stradner) Hay and Mohler, Cyclicargolithus floridanus (Roth and Hay) Bukry, Ericsonia subpertusa (Levin) Martini and Ritzkowski, Neococcolithes dubius (Deflandre) Black, Reticulofenestra callida (Perch-Nielsen) Bybell, Reticulofenestra coenura (Reinhardt) Roth (small), Reticulofenestra ?dictyoda (Deflandre) Stradner, Reticulofenestra minuta Roth, Sphenolithus radians Deflandre, Transversopontis pulchra (Deflandre) Romein,and Zygodiscus sigmoides Bramlette and Sullivan.

Comments
Age equivalent NP14/15 of Martini (1971) based upon the first occurrence of C. floridanus, R. callida and R. dictyoda. Reworking evident.

Whitecliff Bay, sample locality I45 (Fig. 19)

Middle Eocene, Bracklesham Group, Marsh Farm Formation, Fisher bed VIII

(Eaton bed 11), 3m above base of Fisher bed VIII. Laminated clay.

Sample 10M

DINOFLAGELLATE CYSTS (GLE)
Amphorosphaeridium? multispinosum (Davey and Willians), Areosphaeridium diktyoplokus (Klumpp), Cordosphaeridium gracile (Eisenack), Cordosphaeridium inodes (Klumpp), Cribroperidinium tenuitabulatum (Gerlach), Deflandrea phosphoritica Eisenack, Diphyes colligerum (Deflandre and Cookson), Eocladopyxis peniculatum

Morgenroth, Glaphyrocysta exuberans (Deflandre and Cookson), Hystichokolpoma rigaudiae Deflandre and Cookson, Hystrichokolpoma salacium Eaton, Kisselovia tenuivirgula (Williams and Downie), Lingulodinium machaerophorum (Deflandre and Cookson), Operculodinium centrocarpum (Deflandre and Cookson), Polysphaeridium subtile Davey and Williams, Spiniferites ramosus group, Systematophora placacantha (Deflandre and Cookson), Thalassiphora pelagica (Eisenack) and Wetzeliella symmetrica Weiler.

Reworked Jurassic taxa
Cribroperidinium sp., Gonyaulacysta jurassica (Deflandre), Hystrichogonyaulax cladophora (Deflandre) and Sentusidinium rioultii (Sarjeant).

Comments
K.tenuivirgula has its highest occurrence in biozone B-4 (Bujak et al. 1980). The sample is equivalent to W40 of Eaton (1976).

Whitecliff Bay, sample locality I46 (fig. 19)

Middle Eocene, Bracklesham Group, Selsy Sand Formation, Fisher bed XVII,

0.5m above base. Brown clay.

Sample 11F

FORAMINIFERA (JWM)
Articulina laevigata (Terquem), Brizalina anglica (Cushman), Cancris subconicus (Terquem), Cibicides tenellus (Reuss), Cibicides pygmeus (Hantken), *Elphidium latidorsatum (Reuss), *Epistominella vitrea Parker, Fasciolites fusiformis (Sowerby) emend. Adams, Globulina ampulla (Jones), Globulina inaequalis Reuss, *Globulina irregularis d'Orbigny, Guttulina spicaeformis (Roemer), Melonis affine (Reuss), Nummulites variolarius (Lamarck), *Quinqueloculina juleana d'Orbigny and Triloculina trigonula (Lamarck). (* rare).

Comments
Equivalent to sample W98 of Murray and Wright (1974, p.16) and interpreted as representing a shelf sea of normal salinity, with clear water and a temperature of ~18 C (from the presence of Fasciolites).

OSTRACODA (ER)
Cytherella compressa (Munster), Echinocythereis scabropapulosa (Jones), Idiocythere bartoniana Haskins, Haplocytheridea debilis (Jones) and Leguminocythereis haskinsi Keen.

Comments
The assemblage is polyhaline marine offshore, assemblage V, on the margins of VI (Keen, 1978).

Sample 11N

CALCAREOUS NANNOFOSSILS (LTG)
Blackites spinosus (Deflandre) Hay and Towe, Braarudosphaera bigelowi (Gran and Braarud) Deflandre, Chiasmolithus expansus (Bramlette and Sullivan) Gartner, Coccolithus pelagicus (Wallich) Schiller, Discoaster

barbadiensis (Tan) Bramlette and Riedel, Discoaster distinctus Martini, Discoaster wemmelensis Achutan and Stradner, Ericsonia formosa (Kamptner) Romein, Goniolithus fluckigeri Deflandre, Lanternithus minutus Stradner, Lithostromation perdurum Deflandre, Markalius inversus Bramlette and Martini, Micrantholithus vesper Deflandre, Nannotetrina fulgens (Stradner) Achutan and Stradner, Nannotetrina nitida (Martini) Aubry, Neococcolithes dubius (Deflandre) Black, Neococcolithes minutus (Perch-Nielsen) Perch-Nielsen, Pemma basquensis (Martini) Bouche, Pontosphaera multipora (Kamptner) Roth, Reticulofenestra coenura (Reinhardt) Roth, Reticulofenestra dictyoda (Deflandre and Fert) Haq, Reticulofenestra hillae Bukry and Percival, Reticulofenestra minuta Roth, Reticulofenestra scissura Hay, Mohler and Wade, Reticulofenestra umbilica (Levin) Martini and Ritzkowski, Rhabdosphaera sp., Transversopontis pulchra (Deflandre) Romein, and Zygrhablithus bijugatus (Deflandre) Deflandre.

Comments
D.wemmelensis, Nannotetrina spp., P.basquensis and R.dictyoda are indicative of NP15 (Martini 1971). Most abundant and diverse assemblage found. Equivalent level at Bracklesham interesting because of association of Pemma and Nannotetrina species - near-shore environment? Some Cretaceous reworking.

Sample 11M

DINOFLAGELLATE CYSTS (GLE)
Adnatosphaeridium multispinosum Williams and Downie, Areoligera sentosa Eaton, Areosphaeridium arcuatum Eaton, Areosphaeridium diktyoplokus (Klumpp), Cordosphaeridium gracile (Eisenack), Cordosphaeridium inodes (Klumpp), Cribroperidinium tenuitabulatum (Gerlach), Deflandrea phosphoritica Eisenack, Diphyes colligerum (Deflandre and Cookson), Homotryblium tenuispinosum Davey and Williams, Hystrichokolpoma rigaudiae Deflandre and Cookson, Kisselovia tenuivirgula (Williams and Downie), Lingulodinium machaerophorum (Deflandre and Cookson), Melitasphaeridium pseudorecurvatum (Morgenroth), Operculodinium centrocarpum (Deflandre and Cookson), Phthanoperidinium comatum (Morgenroth), Phthanoperidinium echinatum Eaton, Polysphaeridium subtile Davey and Williams, Spiniferites ramosus group, Systematophora placacantha (Deflandre and Cookson) and Thalassiphora delicata Williams and Downie.

Comments
K.tenuivirgula has its highest occurrence in biozone B-4 (Bujak et al. 1980). Sample horizon equivalent to W52 of Eaton (1976).

Whitecliff Bay, sample locality I47 (fig. 20)

Late Eocene, Solent Group, Headon Hill Formation, Colwell Bay Member.

Brown fossiliferous clay.

Sample 12F

FORAMINIFERA (JWM)
Bucella propingua (Reuss), Globigerina angustiumblicata Bolli, Pararotalia curryi Loeblich and Tappan, Protelphidium sp. and

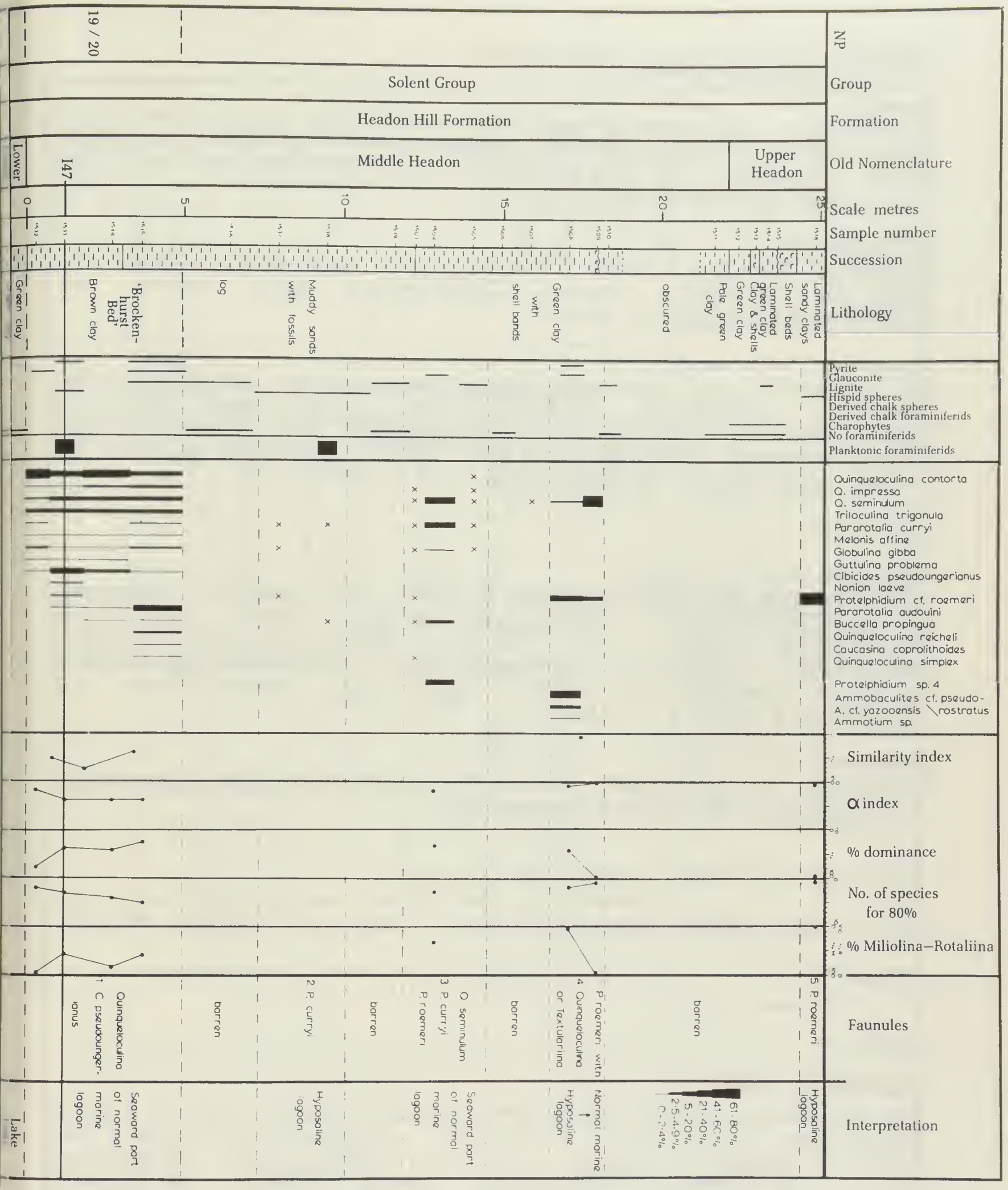


Fig. 20. Text-fig. 9 of Murray and Wright (1974).

Quinqueloculina seminulum (Linne) group.

Comments
Approximately equivalent to sample 1533 of Murray and Wright (1974, p.23) interpreted as representing the seaward part of a lagoon with normal marine salinities. The tiny planktonic tests were transported into the area from an open marine sea.

OSTRACODA (ER)
Cytheretta laticosta (Reuss), Cladarocythere apostolescui (Margerie), Cytheridea intermedia (Reuss), Cytheromorpha bulla Haskins and Eocytheropteron wetherelli (Jones).

Comments
Age diagnostic taxa include C.apostolescui (topmost Bartonian - Lower Rupelian), C.intermedia (Bartonian) and C.bulla (Upper Bartonian) (Keen, 1978). Cladarocythere and Cytheromorpha both indicate brackish water conditions: assemblage IV of Keen (1977), estimated salinity of 9-16% ; Cytheridea and Eocytheropteron would be more marine.

Sample 12M

DINOFLAGELLATE CYSTS (GLE)
Adnatosphaeridium multispinosum Williams and Downie, Deflandrea phosphoritica Eisenack, Glaphyrocysta semitecta (Bujak), Homotryblium tenuispinosum Davey and Williams, Phthanoperidinium comatum (Morgenroth), Rhombodinium perforatum (Jan du Chene and Chateauneuf), Rottnestia borussica (Eisenack), Spiniferites ramosus group and Thalassiphora pelagica (Eisenack).

Comments
Liengjarern et al. (1980) did not record A.multispinosum, R.perforatum or T.pelagica above the Middle Headon Beds.

Whitecliff Bay, sample locality I48 (fig. 21)

Late Eocene, Solent Group, Bembridge Limestone Formation. Micritic limestone.

Sample 14F

CHAROPHYTES (JWM)
The following species have been recorded by Feist-Castel (1977): Grovesichara distorta (Reid and Groves), Gyrogona caelata (Reid and Groves), Gyrogona wrighti (Salter), *Harrisichara tuberculata (Lyell), Nitellopsis (Tectochara) aemula Grambast, Nitellopsis (Tectochara) latispira Feist-Castel, Nitellopsis (Tectochara) wonnacotti+, Psilochara repanda+, Psilochara aff. P.conspicua+, Sphaerochara subglobosa (Groves), *Rhabdochara stockmansi Grambast, and Stephanochara vectensis+. (*recorded form this locality during preparation of the guidebook; + = author unknown)

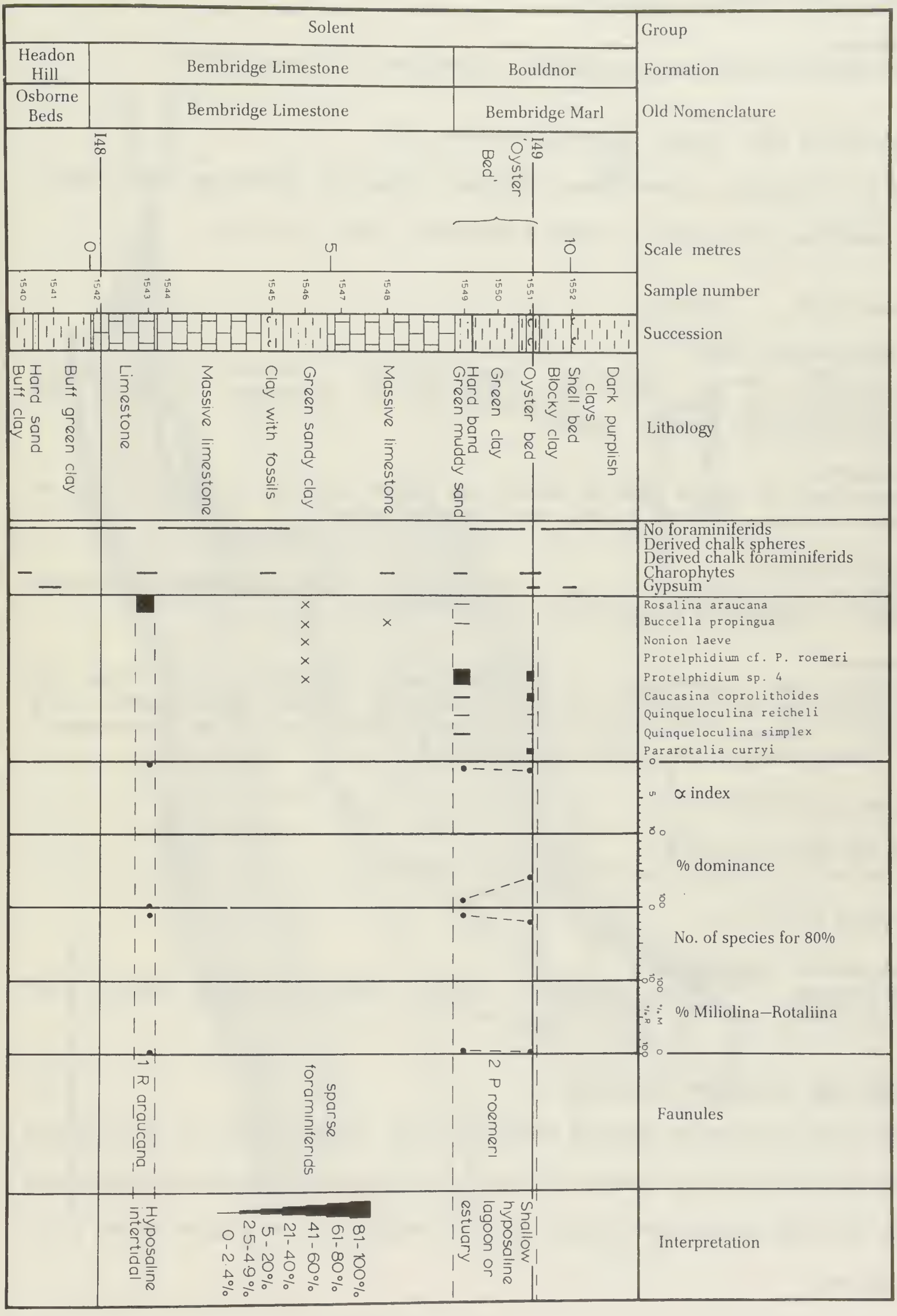


Fig. 21. Text-fig. 10 of Murray and Wright (1974).

OSTRACODA (ER)
Cypridopsis bulbosa (Haskins)

Comments
Freshwater-lacustrine environment: assemblage I of Keen (1977).

Whitecliff Bay, sample locality I49 (fig. 21)

Early Oligocene, Solent Group, Bouldnor Formation, Bembridge Marls Member

= Bembridge Oyster Bed of older literature. Shell-rich clay.

Sample 15F

FORAMINIFERA (JWM)
Brizalina spp., Caucasina coprolithoides (Andreae), Fursenkoina schreibersiana (Czjzck), Protelphidium cf. P.roemeri (Cushman) and Quinqueloculina simplex Terquem.

Comments
Equivalent to sample 1551 of Murray and Wright (1974, p.25) interpreted as representing a shallow hyposaline lagoon or estuary.

OSTRACODA (ER)
Candona cliffendensis Keen, Cypridopsis sp., Cushmanidea stintoni Keen and Cytherura pulchra Keen.

Comments
Candona and Cypridopsis indicate freshwater-lacustrine conditions and Cushmanidea and Cytherura indicate a marine inshore environment. This sample represents an overlap of marine with non-marine environments allowing transfer of specimens either way.

Sample 15M (BAT)

DINOFLAGELLATE CYSTS
Few badly preseved, non-identifiable dinocysts.

Sample 15N (LTG)

CALCAREOUS NANNOFOSSILS
Discoaster binodosus Martini, small Reticulofenestra spp. Poor assemblage, possibly transporte.

Alum Bay SZ 325854 (fig. 22)

The Late Palaeocene Reading Formation rests unconformably on an irregular surface cut in the Campanian chalk. The Palaeogene succession extends up to the late Eocene BartonGroup and is beautifully displayed in the cliff section.

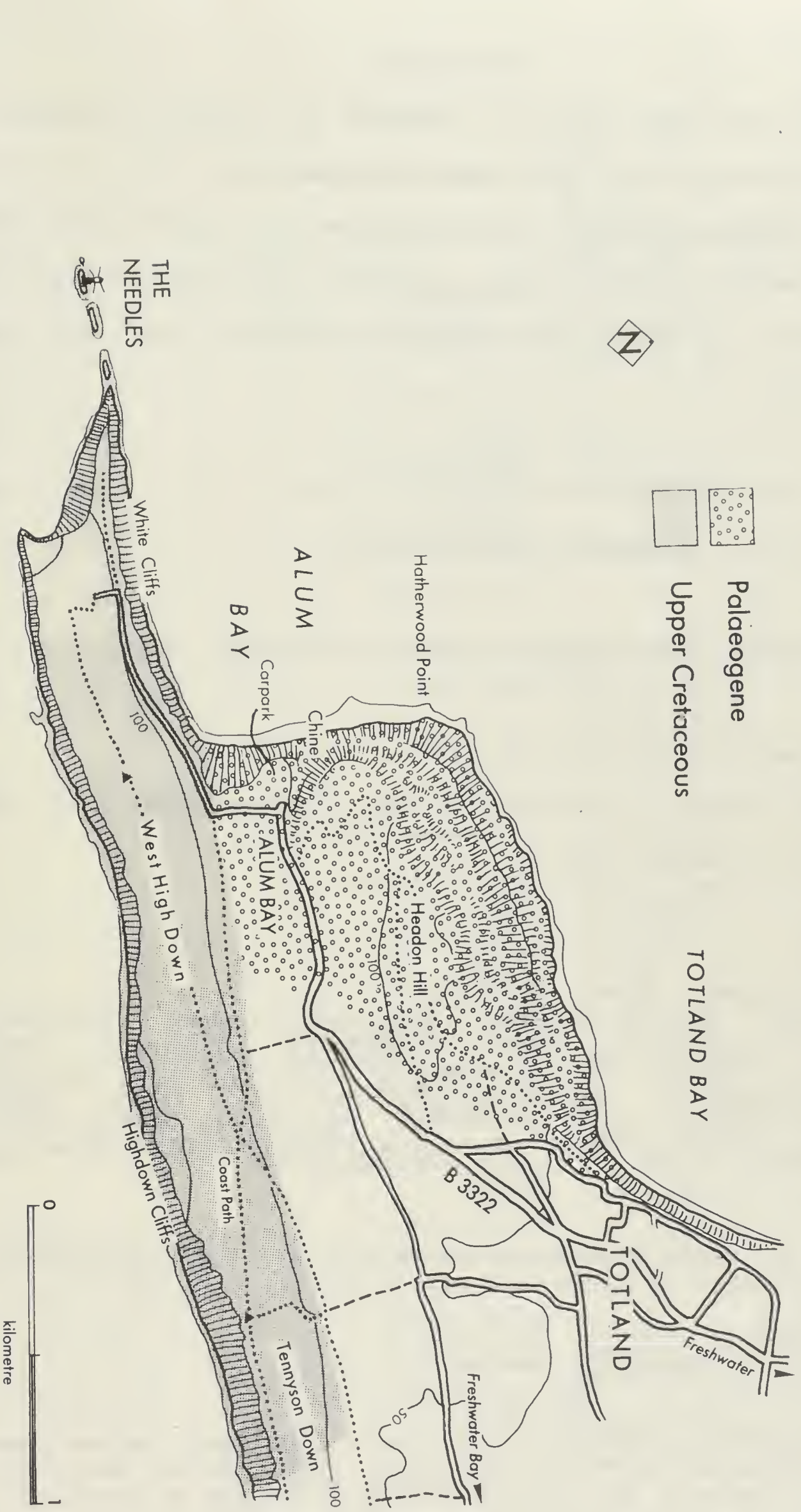


Fig. 22. Map of Alum Bay and Headon Hill.

Although the Reading and London Clay Formations are similar in development to their occurrence in Whitecliff Bay, the Bracklesham Group is quite different, being composed of sands interbedded with lignitic clays. The Wittering, Earnley Sand, Marsh Farm and Selsey Sand Formations cannot be distinguished. The Barton Clay Formation and Barton "Sand" are well exposed.

A summary sketch is given in fig. 23. The letters A to D in the London Clay Formation are the divisions of King (1981).

Reading Formation - hypostratotype (Edwards and Freshney, 1987).

Alum Bay, sample locality I50 (fig. 24)
Early Eocene, London Clay Formation, Division A3 of King (1981, p.92), 10m above base of formation. Grey silty clay.

Sample 16F

FORAMINIFERA (JWM)
*Anomalinoides nobilis Brotzen, Bolivinopsis adamsi (Lalicker), Cibicides cunobelini Haynes, Elphidium hiltermanni Hagn, Epistominella vitrea Parker, Fissurina spp.,*Glandulina laevigata (d'Orbigny),*Gyroidina angustiumblicata Ten Dam, Lagena striata (d'Orbigny), Nonion laeve (d'Orbigny), Pullenia quinqueloba Reuss, Quinqueloculina ludwigi Reuss and Quinqueloculina vulgaris d'Orbigny. (* rare).

Comments
Equivalent to sample A3 of Murray and Wright (1974, p.30) interpreted as representing a shelf of 20-50m depth with a salinity of 32-33‰.

OSTRACODA (ER)
Cytheridea cf. C. newburyensis Gokcen.

Comments
Marine offshore environment. The London Clay suffers faunal impoverishment form clay diagenesis. Pyrite in the fresh clay oxidises and creates acidity which destroys the calcite shells. Weathering at outcrop can be deeply penetrative (brown colouration = weathered).

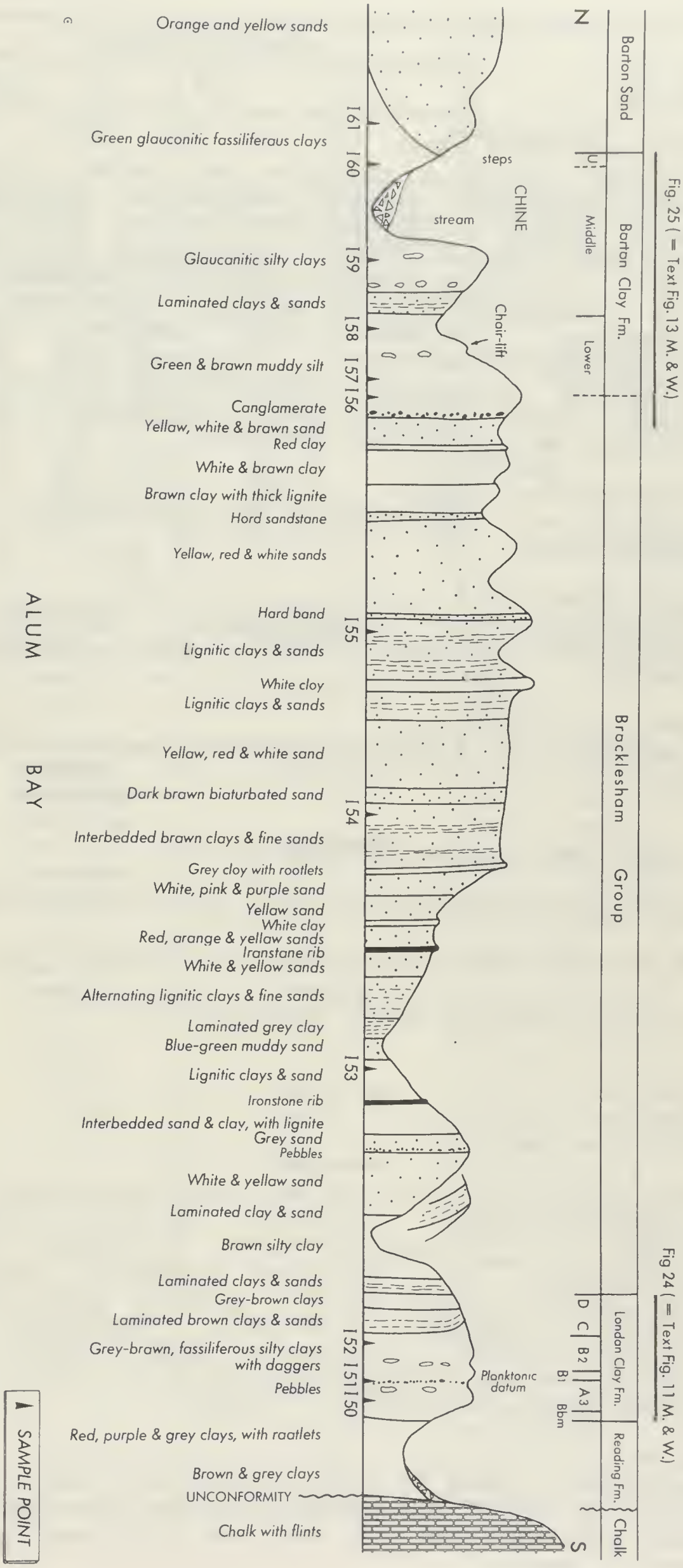


Fig. 23. Sketch section of Alum Bay.
"M. & W." = Murray and Wright (1974).

Sample 16M

DINOFLAGELLATE CYSTS (GLE)
Apectodinium homomorphum (Deflandre and Cookson), Apectodinium parvum (Alberti), Ceratiopsis depressa (Morgenroth), Cordosphaeridium inodes (Klumpp), Diphyes colligerum (Deflandre and Cookson), Glaphyrocysta ordinata (Williams and Downie), Glaphyrocysta divaricata (Williams and Downie), Hystrichosphaeridium tubiferum (Ehrenberg), Lejeunecysta hyalina (Gerlach), Lentinia wetzelii (Morgenroth), Lingulodinium machaerophorum (Deflandre and Cookson), Melitasphaeridium pseudorecurvatum (Morgenroth), Oligosphaeridium complex (White), Operculodinium centrocarpum (Deflandre and Cookson), Operculodinium divergens (Davey and Williams), Spiniferites ramosus group and Thalassiphora delicata Williams and Downie.

Reworked Cretaceous taxa
Chatangiella sp., Hystrichodinium pulchrum Deflandre and Endoscrinium campanulum (Gocht).

Reworked Jurassic taxa
Ctenidodinium sp., Gonyanlacysta jurassica (Deflandre), Nannoceratopsis gracilis Alberti and Sentusidinium rioultii (Sargeant).

Comments
The appearance of L.wetzelii suggests biozone LC-1 of Bujak et al. (1980).

Alum Bay, sample locality I51 (fig. 24)

Early Eocene, London Clay Formation, Division B1 of King (1981, p.92), 21.6m above the base of the formation and 0.5m above the pebble bed at the base of B1 = planktonic datum. Grey silty clay.

Sample 17F

FORAMINIFERA (JWM)

Alabamina obtusa (Burrows and Holland), Anomalinoides nobilis Brotzen, Bolivinopsis adamsi (Lalicker), *Brizalina anglica (Cushman), Cibicides cf. C. cunobelini Haynes, Cibicidoides alleni (Plummer), Cribrostomoides sp., Elphidium hiltermanni Hagn, Epistominella vitrea Parker, *Globulina sp., Gyroidina angustiumbilicata Ten m, *Lenticulina inornata (d'Orbigny), *Nonionella sp., Pullenia quinqueloba (Reuss), Pulsiphonina prima (Plummer), Quinqueloculina vulgaris d'Orbigny, *Turborotalia esnaensis (LeRoy) and *Turborotalia perclara (Loeblich and Tappan). (* rare).

Comments
Equivalent to sample A7 of Murray and Wright (1974, p.30) interpreted as representing a shelf environment of 20-100m water depth, with salinity of 32-33% and circulation with the open sea shown by the presence of planktonic species.

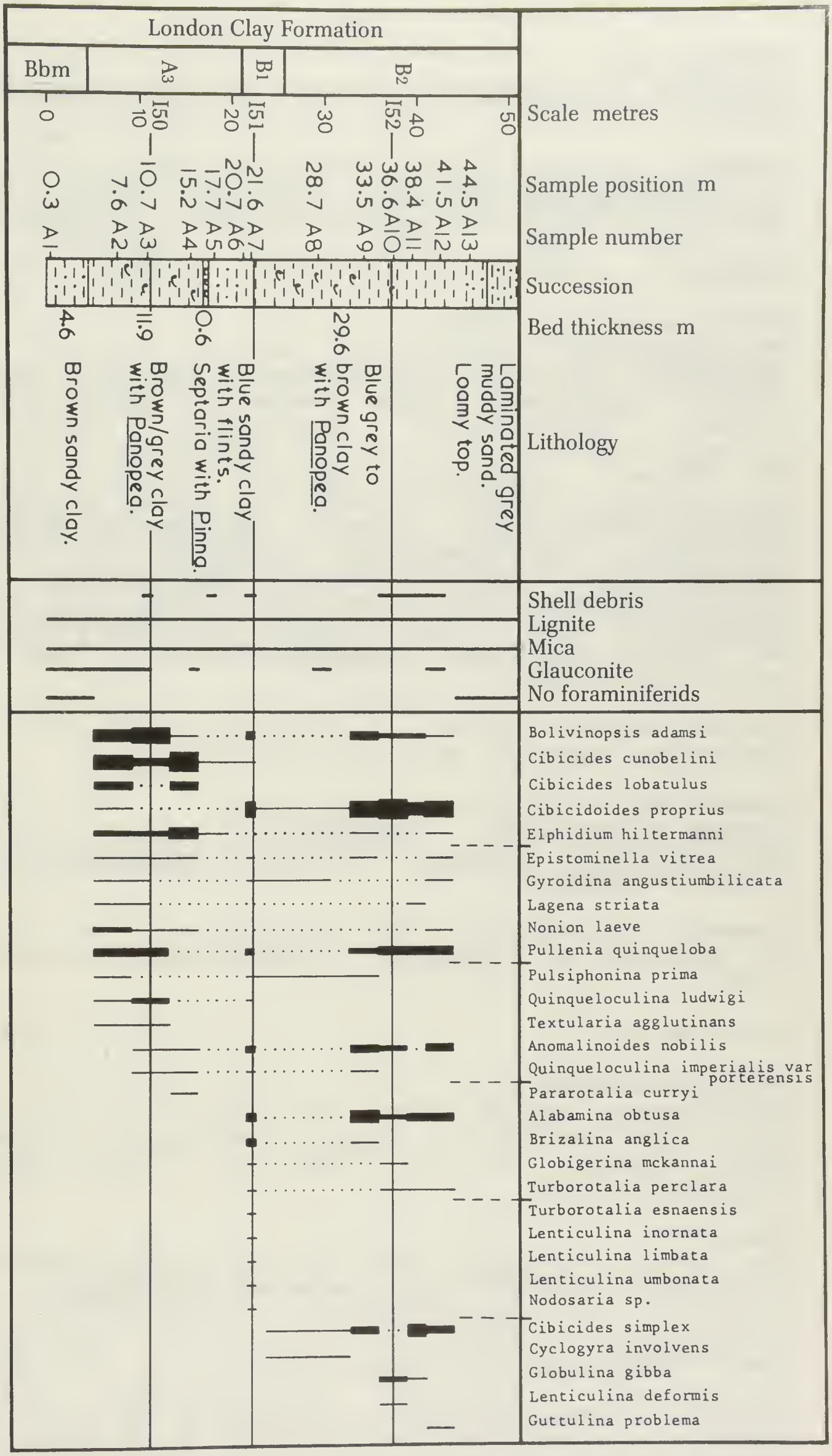


Fig. 24. Text-fig. 11 of Murray and Wright (1974).

OSTRACODA (ER)
Cytheretta scrobiculoplicata (Jones) and Eopaijenborchella eocaenica Triebel.

Comments
C. scrobiculoplicata indicates a Middle Ypresian age (Keen, 1978) and the assemblage represents a marine offshore fauna. Preservation is poor.

Sample 17M

DINOFLAGELLATE CYSTS (GLE)
Amphorosphaeridium? multispinosum (Davey and Williams), Apectodinium homomorphum (Deflandre and Cookson), Areoligera medusettiformis (Wetzel), Ceratiopsis depressa (Morgenroth), Cordosphaeridium inodes (Klumpp), Cribroperidinium tenuitabulatum (Gerlach), Diphyes colligerum (Deflandre and Cookson), Glaphyrocysta exuberans (Deflandre and Cookson), Glaphyrocysta pastielsii (Deflandre and Cookson), Hystrichokolpoma rigaudiae Deflandre and Cookson, Hystrichosphaeridium patulum Davey and Williams, Hystrichosphaeridium tuberiferum (Ehrenberg), Melitasphaeridium pseudorecurvatum (Morgenroth), Oligosphaeridium complex (White), Operculodinium centrocarpum (Deflandre and Cookson), Spiniferites ramosus group, Systematophora placacantha (Deflandre and Cookson), Thalassiphora delicata Williams and Davey, Thalassiphora pelagica (Eisenack) and Wetzeliella meckelfeldensis Gocht.

Reworked Cretaceous taxa
Odontochitina operculata (Wetzel) and Subtilisphaera sp.

Reworked Jurassic taxa
Cribroperidinium sp., Gonyaulacysta jurassica (Deflandre), Hystrichogonyaulax cladophora (Deflandre), Systematophora fasiculigera Klement and Wanaea sp.

Comments
The appearance of H.rigaudiae indicates biozone LC-1 of Bujak et al. (1980).

Sample 17N (LTG)

CALCAREOUS NANNOFOSSILS
Braarudosphaera bigelowi (Gran and Braarud) Deflandre, Coccolithus pelagicus (Wallich) Schiller, Neococcolithes dubius (Deflandre) Black, Toweius pertusus (Sullivan) Romein and Transversopontis cf. T. rectipons (Haq) Roth.

Comments
The presence of N.dubius (NP11-16) and T.pertusus (NP6-12) indicates an age of NP11-12 (Martini, 1971). Impoverished assemblage.

Alum Bay, sample locality I52 (Fig. 24)

Early Eocene, London Clay Formation, Division B2 of King (1981, p.92), 36.6m above the base of the formation and 15m above the pebble bed at the base of B1. Grey silty clay.

Sample 18F

FORAMINIFERA (JWM)
Alabamina obtusa (Burrows and Holland), Anomalinoides nobilis Brotzen, *Bolivinopsis adamsi (Lalicker), Brizalina anglica (Cushman), Cibicides cunobelini Haynes, Cibicidoides alleni (Plummer), *Elphidium hiltermanni Hagn, *Nonion laeve (d'Orbigny), Quinqueloculina vulgaris d'Orbigny and reworked Cretaceous heterohelicids. (* rare).

Comments
Equivalent to sample A10 of Murray and Wright (1974, p.30) interpreted as representing a shelf sea of 20-100m water depth with salinity of 32-33‰.

Sample 18M

DINOFLAGELLATE CYSTS (GLE)
Adnatosphaeridium multispinosum Williams and Downie, Apectodinium homomorphum(Deflandre and Cookson), Cribroperidinium tenuitabulatum (Gerlach), Diphyes colligerum (Deflandre and Cookson), Homotryblium tenuispinosum Davey and Williams, Hystrichosphaeridium tubiferum (Ehrenberg), Spiniferites ramosus group, Thalassiphora delicata Williams and Downie and Wetzeliella meckelfeidensis Gocht.

Reworked Cretaceous taxa
Chlamydophorella sp., Dinodinium albertii Sarjeant.

Reworked Jurassic taxa
Ctenidodinium sp., Gonyaulacysta jurassica (Deflandre), Hystrichogonyaulax cladophora (Deflandre), Leptodinium mirabile Klement, Nannoceratopsis gracilis Alberti.

Comments
The appearance of A.multispinosum and H.tenuispinosum indicates biozone LC-2 of BUjak et al. (1980).

Alum Bay, sample locality I53

Early Eocene, Bracklesham Group, Prestwich bed 10 (Eaton bed 2c).

Laminated brown clays and sands.

Sample 19M

DINOFLAGELLATE CYSTS (GLE)
Apectodinium homomorphum (Deflandre and Cookson), Areoligera senonensis Lejeune-Carpentier, Cordosphaeridium inodes (Klumpp), Diphyes colligerum (Deflandre and Cookson), Glaphyrocysta exuberans (Deflandre and Cookson), Homotryblium abbreviatum Eaton, Melitasphaeridium pseudorecurvatum (Morgenroth), Operculodinium centrocarpum (Deflandre and Cookson), Palaeocystodinium golzowense Alberti, Phthanoperidinium echinatum Eaton and Spiniferites ramosus group.

Reworked Jurassic taxa
Ctenidodinium ornatum (Eisenack) and Nannoceratopsis gracilis Alberti.

Comments
The appearance of P.echinatum indicates biozone B-1 of Bujak et al. (1980). Equivalent to sample AB4 of Eaton (1976).

Alum Bay, sample locality I54

Early Eocene, Bracklesham Group, Prestwich bed 20 (Eaton bed 9). Laminated clay.

Sample 20M

DINOFLAGELLATE CYSTS (GLE)
Apectodinium homomorphum (Deflandre and Cookson), Areoligera tauloma Eaton, Cordosphaeridium inodes (Klumpp), Cribroperidinium tenuitabulatum (Gerlach), Diphyes colligerum (Deflandre and Cookson), Homotryblium tenuispinosum Davey and Williams, Lingulodinium machaerophorum (Deflandre and Cookson), Phthanoperidinium comatum (Morgenroth), Spiniferites ramosus group, Systematophora placacantha (Deflandre and Cookson), Thalassiphora delicata Williams and Downie and Wetzeliella symmetrica Weiler.

Reworked Jurassic taxa
Hystrichogonyaulax cladophora (Deflandre).

Comments
The appearance of A.tauloma and P.comatum indicates biozone B-3 of Bujak et al. (1980). Equivalent to sample AB19 of Eaton (1976).

Alum Bay, sample locality I55

Middle Eocene, Bracklesham Group, Prestwich Bed 24 (Eaton bed 14d). Brown laminated clays.

Sample 21M

DINOFLAGELLATE CYSTS (GLE)
Achilleodinium biformoides (Eisenack), Adnatosphaeridium multispinosum Williams and Downie, Areosphaeridium arcuatum Eaton, Cordosphaeridium gracile (Eisenack), Cordosphaeridium inodes (Klumpp), Cribroperidinium tenuitabulatum (Gerlach), Diphyes colligerum (Deflandre and Cookson), Glaphyrocysta vicina (Eaton), Homotryblium abbreviatum Eaton, Homotryblium tenuispinosum Davey and Williams, Kisselovia tenuivirgula (Williams and Downie), Lingulodinium machaerophorum (Deflandre and Cookson), Melitasphaeridium pseudorecurvatum (Morgenroth), Pentadinium laticinctum Gerlach and Spiniferites ramosus group.

Reworked Jurassic taxa
Cribroperidinium sp., Sentusidinium pilosum (Ehrenberg) and

Systematophora areolata Klement.

Comments
The appearance of A.arcuatum with K.tenuivirgula indicates biozone B-4 of Bujak et al. (1980). Equivalent to sample AB28 (Eaton 1976).

Alum Bay, sample locality I56

Late Eocene, Bracklesham Group, Prestwich bed 29 (Eaton bed 19). 3m above conglomeratic pebble bed. Brown muddy silt.

Sample 22M

DINOFLAGELLATE CYSTS (GLE)
Araneosphaera araneosa Eaton, Areoligera sentosa Eaton, Areoligera tauloma Eaton, Areoligera undulata Eaton, Areosphaeridium arcuatum Eaton, Areosphaeridium diktyoplokus (Klumpp), Areosphaeridium multicornutum Eaton, Cordosphaeridium inodes (Klumpp), Cribroperidinium tenuitabulatum (Gerlach), Deflandrea phosphoritica Eisenack, Diphyes colligerum (Deflandre and Cookson), Heteraulacacysta leptalea Eaton, Homotryblium tenuispinosum Davey and Williams, Hystrichokolpoma rigaudiae Deflandre and Cookson, Kisselovia coleothrypta (Williams and Downie), Oligosphaeridium complex (White), Operculodinium centrocarpum (Deflandre and Cookson), Pentadinium laticinctum Gerlach, Samlandia chlamydophora Eisenack, Spiniferites ramosus group, Thalassiphora delicata Williams and Downie and Wetzeliella symmetrica Weiler.

Reworked Cretaceous taxa
Coronifera oceanica Cookson and Eisenack, Dingodinium alberti Sarjeant, Surculosphaeridium longifurcatum (Firtion), Cribroperidinium sp., Hystrichogonyaulax cladophora (Deflandre), Pareodinia ceratophora Deflandre and Systematophora orbifera Klement.

Comments
The appearance of A.undulata and A.multicornatum and the occurrence of A.sentosa indicates biozone B-5 of Bujak et al. (1980). Equivalent to sample AB40 of Eaton (1976).

Alum Bay, sample locality I57 (fig. 25)

Late Eocene, Barton Clay Formation, 16m above conglomeratic pebble bed.

Grey clay.

Sample 31F

FORAMINIFERA (JWM)
Brizalina anglica (Cushman), Buccella propingua (Reuss), Cibicides ungerianus (d'Orbigny), Cibicidoides pygmeus (Hantken), *Cribrostomoides sp., Elphidium latidorsatum (Reuss), Globigerina angustiumbilicata Bolli, Globulina gibba d'Orbigny, Melonis affine (Reuss), +Nummulites prestwichianus (Jones), Protelphidium sp.1

Murray and Wright, 1974 and *Robertina germanica Cushman and Parker. (* rare; + type locality)

Comments
Equivalent to sample 1317 of Murray and Wright (1974, p.33) and interpreted as representing a shelf, <100m depth, salinity 32-33‰.

Sample 31M

DINOFLAGELLATE CYSTS (BAT)
Adnatosphaeridium multispinosum Williams and Downie, Areoligera undulata Eaton, Areosphaeridium arcuatum Eaton, Areosphaeridium diktyoplokus (Klumpp), Dapsilidinium simplex (White), Deflandrea phosphoritica Eisenack, Distatodinium craterum Eaton, Homotryblium tenuispinosum Davey and Williams, Hystrichokolpoma rigaudiae Deflandre and Cookson, Kisselovia coleothrypta (Williams and Downie), Melitasphaeridium pseudorecurvatum (Morgenroth), Oligosphaeridium complex (White), Palaeocystodinium golzowense Alberti, Selenopemphix armata Bujak, Spiniferites ramosus group, Thalassiphora pelagica (Eisenack) and Wetzeliella articulata Eisenack.

Comments
The co-occurrence of D.craterum and A.undulata with D.simplex and S.armata suggests that sample 31M is equivalent to biozone BAR-1 of Bujak et al. (1980).

Sample 31N

CALCAREOUS NANNOFOSSILS (LTG)
Blackites spinosus (Deflandre and Fert) Hay and Towe, Coccolithus pelagicus (Wallich) Schiller, Cyclicargolithus floridanus (Roth and Hay) Bukry, Neococcolithes dubius (Deflandre) Black, Pemma basquensis (Martini) Bouche, Reticulofenestra coenura (Reinhardt) Roth, Reticulofenestra dictyoda (Deflandre and Fert) Stradner, Reticulofenestra foveolata (Reinhardt) Roth, Reticulofenestra minuta Roth, Reticulofenestra umbilica (Levin) Martini and Ritzkowski and Transversopontis pulchra (Deflandre) Romein.

Comments
The presence of N.dubius, P.basquensis and R.umbilica infers an age equivalent to NP15/16. Some Cretaceous reworking.

Alum Bay, sample locality I58 (fig. 25)

Late Eocene, Barton Clay Formation, ~26m above the conglomeratic pebble bed. Grey clay.

Sample 30F

FORAMINIFERA (JWM)
Cibicides ungerianus (d'Orbigny), Cibicidoides pygmeus (Hantken), Elphidium latidorsatum (Reuss), Fissurina sp., Fursenkoina schreibersiana (Czjzek), Globigerina angustiumbilicata Bolli, Globulina gibba (d'Orbigny), Melonis affine (Reuss), Miliolinella spp., Nummulites rectus Curry, Protelphidium sp.1 of Murray and

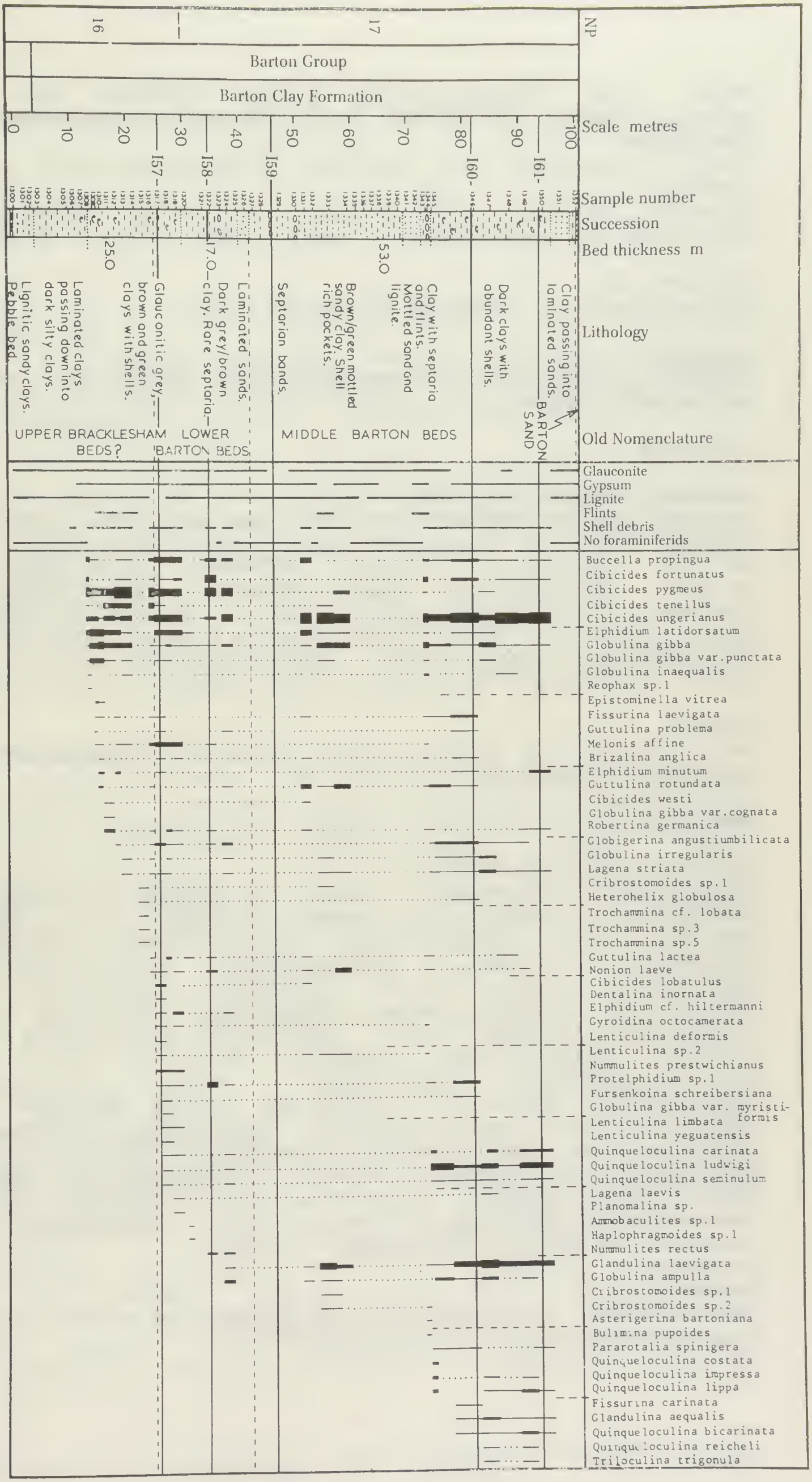


Fig. 25. Text-fig. 13 of Murray and Wright (1974).

Wright 1974, Quinqueloculina juleana d'Orbigny and Robertina germanica Cushman and Parker. Rare reworked Cretaceous heterohelicids also present.

Comments
Equivalent to sample 1322 of Murray and Wright (1974, p.33) and interpreted as representing a shelf, <100m, salinity 32-33% .

OSTRACODA (ER)
Echinocythereis sp. and Krithe bartonensis (Jones).

Comments
Indicative of a marine offshore environment. Barton Clay assemblages usually more diverse.

Sample 30N

CALCAREOUS NANNOFOSSILS (LTG)
Blackites spinosus (Deflandre and Fert) Hay and Towe, Braarudosphaera bigelowi (Gran and Braarud) Deflandre, Coccolithus pelagicus (Wallich) Schiller, Goniolithus fluckigeri Deflandre, Lanternithus minutus Stradner, Micrantholithus vesper Deflandre, Neococcolithes dubius (Deflandre) Black, Pemma basquensis (Martini) Bouche, Reticulofenestra coenura (Reinhardt) Roth, Reticulofenestra foveolata (Reinhardt) Roth, Reticulofenestra minuta Roth, Reticulofenestra umbilica (Levin) Martini and Ritzkowski and Transversopontis pulchra (Deflandre) Romein.

Comments
The presence of the Reticulofenestra assemblage together with N.dubius indicates an NP15/16 age.

Sample 30M

DINOFLAGELLATE CYSTS (BAT)
Achilleodinium biformoides (Klumpp), Adnatosphaeridium multispinosum Williams and Downie, Araneosphaera araneosa Eaton, Areoligera undulata Eaton, Areosphaeridium arcuatum Eaton, Areosphaeridium diktyoplokus (Klumpp), Areosphaeridium multicornutum Eaton, Dapsilidinium simplex (White), Deflandrea phosphoritica Eisenack, Distatodinium craterum Eaton, Distatodinium ellipticum (Cookson), Glaphyrocysta intricata (Eaton), Homotryblium tenuispinosum Davey and Williams, Hystrichokolpoma rigaudiae Deflandre and Cookson, Hystrichosphaeropsis rectangularis Bujak, Hystrichostrogylon membraniphorum Agelopoulos, Lejeunecysta hyalina (Gerlach), Lentinia serrata Bujak, Melitasphaeridium pseudorecurvatum (Morgenroth), Oligosphaeridium complex (White), Palaeocystodinium golzowense Alberti, Phthanoperidinium geminatum Bujak, Phthanoperidinium multispinum Bujak, Rhombodinium draco Gocht, Rhombodinium longimanum Vozzhennikova, Spiniferites ramosus group, Thalassiphora pelagica (Eisenack) and Wetzeliella articulata Eisenack.

Comments
The appearance of P.multispinum and R.longimanum and the occurrence of A.multicornutum indicate biozone BAR-3/BAR-4.

Alum Bay, sample locality I59 (fig. 25)

Late Eocene, Barton Clay Formation, ~39m above the conglomeratic pebble bed. Grey clay.

Sample 29F

FORAMINIFERA (JWM)
Brizalina sp., Buccella propingua (Reuss), Cibicides ungerianus (d'Orbigny), Globigerina angustiumbilicata Bolli, Globulina ampulla (Jones), Globulina gibba (d'Orbigny), Globulina irregularis d'Orbigny and Nonion laeve (d'Ordigny). (rare)

Comments
Equivalent to sample 1329 of Murray and Wright (1974, p.33) but that was barren. The environment is interpreted as shelf, <100m, salinity ~35‰.

OSTRACODA (ER)
Pterygocythereis fimbriata bartonenesis Keij.

Comments
Indicates a marine offshore environment: assemblage V of Keen (1977).

Sample 29N

CALCAREOUS NANNOFOSSILS (LTG)
Blackites spinosus (Deflandre and Fert) Hay and Towe, Coccolithus pelagicus (Wallich) Schiller, Ericsonia fenestrata (Deflandre and Fert) Stradner, Lanternithus minutus Stradner, Reticulofenestra coenura (Reinhardt) Roth, Reticulofenestra minuta Roth, Reticulofenestra reticulata (Gartner and Smith) Roth and Thierstein, Reticulofenestra umbilica (Levin) Martini and Ritzkowski, Transversopontis pulchra (Deflandre) Romein and Zygrhablithus bijugatus (Deflandre) Deflandre.

Comments
Age NP16/17 based on the occurrence of R.reticulata.

Sample 29M

DINOFLAGELLATE CYSTS (BAT)
Adnatosphaeridium multispinosum Williams and Downie, Areoligera undulata Eaton, Areosphaeridium diktyoplokus (Klumpp), Areosphaeridium fenestratum Bujak, Areosphaeridium multicornutum Eaton, Dapsilidinium simplex (White), Deflandrea phosphoritica Eisenack, Distatodinium craterum Eaton, Glaphyrocysta semitecta Bujak, Hystrichokolpoma rigaudiae Deflandre and Cookson, Hystrichostrogylon membraniphorum Agelopoulos, Kisselovia coleothrypta (Williams and Downie), Lentinia serrata Bujak, Palaeocystodinium golzowense Alberti, Rhombodinium longimanum Vozzihennikova, Spiniferites ramosus group, Thalassiphora delicata Williams and Downie, Thalassiphora pelagica (Eisenack) and Wetzeliella articulata Eisenack.

Comments
The occurrence of R.longimanum with T.delicata indicates biozone

BAR-3/BAR-4 of Bujak et al. (1980).

Alum Bay, sample locality I60 (fig. 25)

Late Eocene, Barton Clay Formation, 3m to the north of the steps. Brown clay.

Sample 28F

FORAMINIFERA (JWM)
Ammobaculites sp., Brizalina spp., Buccella propingua (Reuss), Cibicides ungerianus (d'Orbigny), Elphidium minutum (Reuss), Fursenkoina sp., Glandulina laevigata (d'Orbigny), Nonion laeve (d'Orbigny), Pararotolia spinigera (Le Calvez), Quinqueloculina bicarinata d'Orbigny and Quinqueloculina juleana d'Orbigny. Rare reworked Cretaceous heterohelicids also present.

Comments
Approximately equivalent to sample 1346 of Murray and Wright (1974, p.33) interpreted as representing a nearshore shelf, depth <50m and salinity 32-33‰.

OSTRACODA (ER)
Krithe bartonensis (Jones), Occultocythereis costalis costalis Haskins and Pterygocythereis fimbriata bartonensis Keij.

Comments
The assemblage represents a marine offshore environment: assemblage V of Keen (1977).

Sample 28N

CALCAREOUS NANNOFOSSILS (LTG)
Blackites spinosus (Deflandre and Fert) Hay and Towe, Braarudosphaera bigelowi (Gran and Braarud) Deflandre, Cepekiella lumina (Sullivan) Bybell, Coccolithus pelagicus (Wallich) Schiller, Discoaster wemmelensis Achutan and Stradner, Ericsonia fenestrata (Deflandre and Fert) Stradner, Ericsonia subdisticha (Roth and Hay) Roth, Lanternithus minutus Stradner, Neococcolithes minutus (Perch-Nielsen)Perch-Nielson, Pemma basquensis (Martini) Bouche, Reticulofenestra foveolata (Reinhardt) Roth, Reticulofenestra minuta Roth, Reticulofenestra reticulata (Gartner and Smith) Roth and Theirstein, Reticulofenestra umbilica (Levin) Martini and Ritzkowski, Transversopontis pulchra (Deflandre) Romein and Zygrhablithus bijugatus (Deflandre) Deflandre.

Comments
Age equivalent to NP16/17 based on the presence of D.wemmelensis, E.fenestrata, P.basquensis and R.reticulata. Abundant reworked Cretaceous taxa.

Sample 28M

DINOFLAGELLATE CYSTS (BAT)
Adnatosphaeridium multispinosum Williams and Downie, Areosphaeridium

arcuatum Eaton, Areosphaeridium fenestratum Bujak, Cerebrocysta bartonensis Bujak, Cordosphaeridium funiculatum Morgenroth, Corrudinium incompositum (Drugg), Dapsilidinium simplex (White), Deflandrea phosphoritica Eisenack, Distatodinium paradoxum (Brosius), Hystrichokolpoma rigaudiae Deflandre and Cookson, Hystrichosphaeropsis rectangularis Bujak, Hystrichostrogylon membraniphorum Agelopoulos, Kisselovia coleothrypta (Williams and Downie), Lejeunecysta cinctoria (Bujak), Lentinia serrata Bujak, Lingulodinium machaerophorum (Deflandre and Cookson), Palaeocystodinium golzowense Alberti, Rhombodinium longimanum Vozzhennikova, Rottnestia borussica (Eisenack), Selenopemphix armata Bujak, Spiniferites ramosus group and Thalassiphora pelagica (Eisenack).

Comments
The appearance of R.longimanum indicates biozone BAR-3 of Bujak et al. (1980).

Alum Bay, sample locality I61 (fig. 25)

Late Eocene, Barton Clay Formation, 5m below the junction with the Barton "Sand".

Sample 27F

FORAMINIFERA (JWM)
Ammobaculites sp., Buccella propingua (Reuss), Cibicides ungerianus (d'Orbigny), Elphidium minutum (Reuss), Glandulina laevigata (d'Orbigny), Nonion laeve (d'Orbigny). Rare reworked Cretaceous heterohelicids also present.

Comments
Approximately equivalent to sample 1350 of Murray and Wright (1974, p.33) interpreted as representing a nearshore shelf, depth <50m and salinity 32-33% .

Sample 27N

CALCAREOUS NANNOFOSSILS (LTG)
Blackites spinosus (Deflandre and Fert) Hay and Towe, Coccolithus pelagicus (Wallich) Schiller, Reticulofenestra minuta Roth, Reticulofenestra umbilica (Levin) Martini and Ritzkowski and Transversopontis pulchra (Deflandre) Romein.

Comments
Abundant reworked Cretaceous taxa in a poor but in situ assemblage.

Sample 27M

DINOFLAGELLATE CYSTS (BAT)
Adnatosphaeridium multispinosum Williams and Downie, Areoligera undulata Eaton, Areosphaeridium diktyoplokus (Klumpp), Areosphaeridium multicornutum Eaton, Cerebrocysta bartonensis Bujak, Glaphyrocysta microfenestratum (Bujak), Hystrichokolpoma rigaudiae Deflandre and Cookson, Hystrichostrogylon membraniphorum

Agelopoulos, Kisselovia coleothrypta (Williams and Downie), Lejeunecysta cinctoria (Bujak), Lentinia serrata Bujak, Lingulodinium machaerophorum (Deflandre and Cookson), Oligosphaeridium complex (White), Palaeocystodinium golzowense Alberti, Phthanoperidinium comatum (Morgenroth), Pterodinium cingulatum cingulatum and Spiniferites ramosus group.

Comments
The appearance of G. microfenestratum and the occurrence of A. multicornutum indicate biozone BAR-4/BAR-5 of Bujak et al. (1980).

Headon Hill SZ 306860 (fig. 2)

The slopes of Headon Hill above the white sands of the Barton "Sand" are disturbed by landslips but it is usually possible to piece together the succession of the lower part of the Headon Hill Formation (fig.26).

This locality is the stratotype of the Headon Hill Formation and the Hatherwood Limestone Member (Insole and Daley 1985).

Headon Hill, sample locality I62 (fig. 27)

Late Eocene, Solent Group, Headon Hill Formation, Colwell Bay Member.

Oyster-rich clay.

Sample 24F

FORAMINIFERA (JWM)
Caucasina coprolithoides (Andreae), Nonion parvulum (Grzybowski), Pararotolia curryi Loeblich and Tappan and Protelphidium cf. P.roemeri (Cushman). Reworked Cretaceous heterohelicids also present.

Comments
Equivalent to sample 1373 of Murray and Wright (1974, p.36) interpreted as representing a hyposaline lagoon.

CHAROPHYTES
Oogonia are present, probably transported in by rivers.

OSTRACODA (ER)
Cytheretta porosacosta Keen, Cytheromorpha zinndorfi (Lienenklaus) and Loxoconcha sp. Keen.

Comments
C. zinndorfi ranges from the Lower Rupelian to the Chattian. The assemblage represents a nearshore marine environment with salinities ranging from 10% (Cythermorpha) to +20% (Cytheretta/Loxoconcha).

HEADON HILL

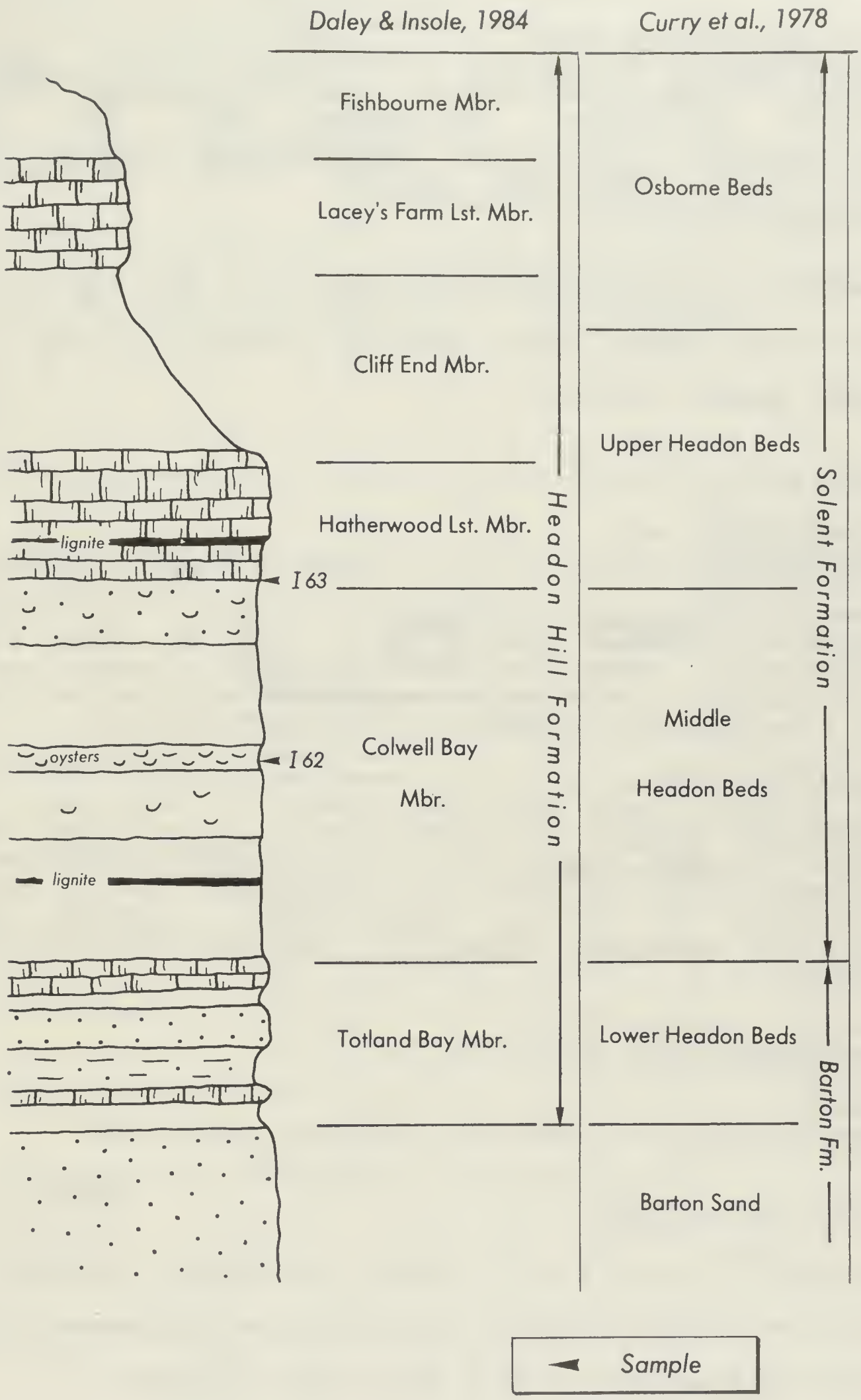


Fig. 26. Sketch section of NE corner of Headon Hill.

Sample 24M

DINOFLAGELLATE CYSTS (BAT)
Adnatosphaeridium multispinosum Williams and Downie, Homotryblium floripes (Deflandre and Cookson) ssp. breviradiatum (Cookson and Eisenack), Homotryblium tenuispinosum Davey and Williams, Hystrichokolpoma cinctum Klumpp, Hystrichokolpoma rigaudiae Deflandre and Cookson, Impagidinium? simplicium (Cookson and Eisenack) and Phthanoperidinium comatum (Morgenroth).

Headon Hill, sample locality I63 (fig. 27)

Late Eocene, Solent Group, Headon Hill Formation, Hatherwood Limestone Member. Micritic Limestone.

Sample 23F

FORMAMINIFERA (JWM)
Quinqueloculina reicheli Le Calvez and Rosalina araucana d'Orbigny.

Comments
Equivalent to sample 1361 of Murray and Wright (1974, p.36) and interpreted as representing conditions within a lagoon of near normal marine salinity. However, the presence of charophytes may mean that there was a seasonal change from marine to freshwater conditions.

CHAROPHYTES (JWM)
The following species have been recorded by Feist-Castel (1977): Grovesichara distorta (Reid and Groves), Gyrogona caelata (Reid and Groves), Gyrogona wrighti (Salter), Harrisichara intermediate between vasiformis (Reid and Groves) and tuberculata (Lyell), Nitellopsis (Tectochara) aff. N (T). aemula Grambast, Psilochara repanda+, Psilochara conspicua+, Sphaerochara subglobosa (Groves). (+ author unknown).

OSTRACODA (ER)
Cypridopsis bulbosas (Haskins).

Comments
Freshwater-lacustrine assemblage: assemblage I (Keen, 1977).

Colwell Bay SZ 329882

The low cliffs expose a section through the Headon Hill Formation from the top of the Totland Bay Member, through the Colwell Bay Member (stratotype, Insole and Daley 1981) to the Hatherwood Limestone Member.

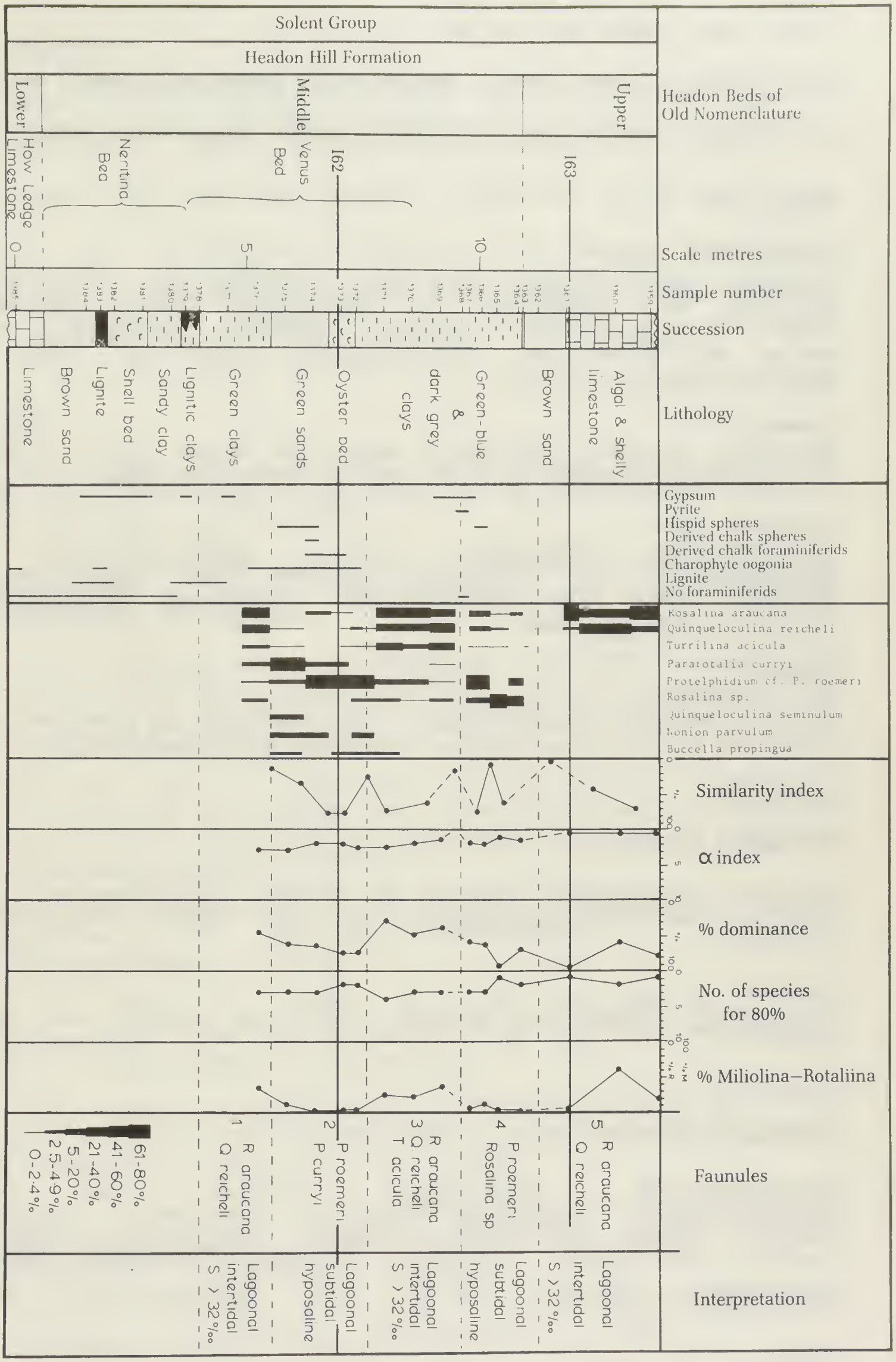


Fig. 27. Text-fig. 15 of Murray and Wright (1974).

Colwell Bay, sample locality I64

Late Eocene, Solent Group, Headon Hill Formation, Colwell Bay Member (stratotype) = oyster bed of the Middle Headon Beds of older nomenclature.

Sample 32F

FORAMINIFERA (JWM)
Caucasina coprolithoides (Andreae), Cibicides sp., Fissurina sp., Guttulina sp., Gyroidina sp., Pararotalia curryi Loeblich and Tappan, Protelphidium cf. P.roemeri (Cushman), Protelphidium sp.4 of Murray and Wright 1974, Quinqueloculina reicheli Le Calvez, and Rosalina araucana d'Orbigny.

Comments
Equivalent to samples 2055-2059 of Murray and Wright (1974, p.39) and interpreted as representing a very shallow hyposaline lagoon.

OSTRACODA (ER)
Eocytheropteron wetherelli (Jones), Eopaijenborchella sp., Haplocytheridea sp., Hazelina indigena Moos, Leguminocythereis delirata (Jones and Sherborn) and Schuleridea (Aequacytheridea) perforata headonensis Keen.

Comments
The assemblage is more marine than most found in the Headon Beds and includes critical polyhaline forms such as Hazelina (assemblage VI of Keen 1977).

Sample 32N

CALCAREOUS NANNOFOSSILS (LTG)

Discoaster saipanensis Bramlette and Riedel, Reticulofenestra minuta Roth and small Reticulofenestra umbilica (Levin) Martini and Ritzkowski.

Comments
D.saipanensis ranges from NP16-20. Very low diversity and density assemblage.

Sample 32M

DINOFLAGELLATE CYSTS (GLE)

Adnatosphaeridium multispinosum Williams and Downie, Cordosphaeridium funiculatum Morgenroth, Corrudinium incompositum (Drugg), Glaphyrocysta semitecta (Bujak), Impagidinium? simplicium (Cookson and Eisenack), Kisselovia coleothrypta (Williams and Downie), Lejeunecysta cinctoria (Bujak) and Phthanoperidinium comatum (Morgenroth).

Comments
No particularly age diagnostic taxa present, although Liengjarern et al. (1980) did not record C. funiculatum above the Middle Headon Beds.

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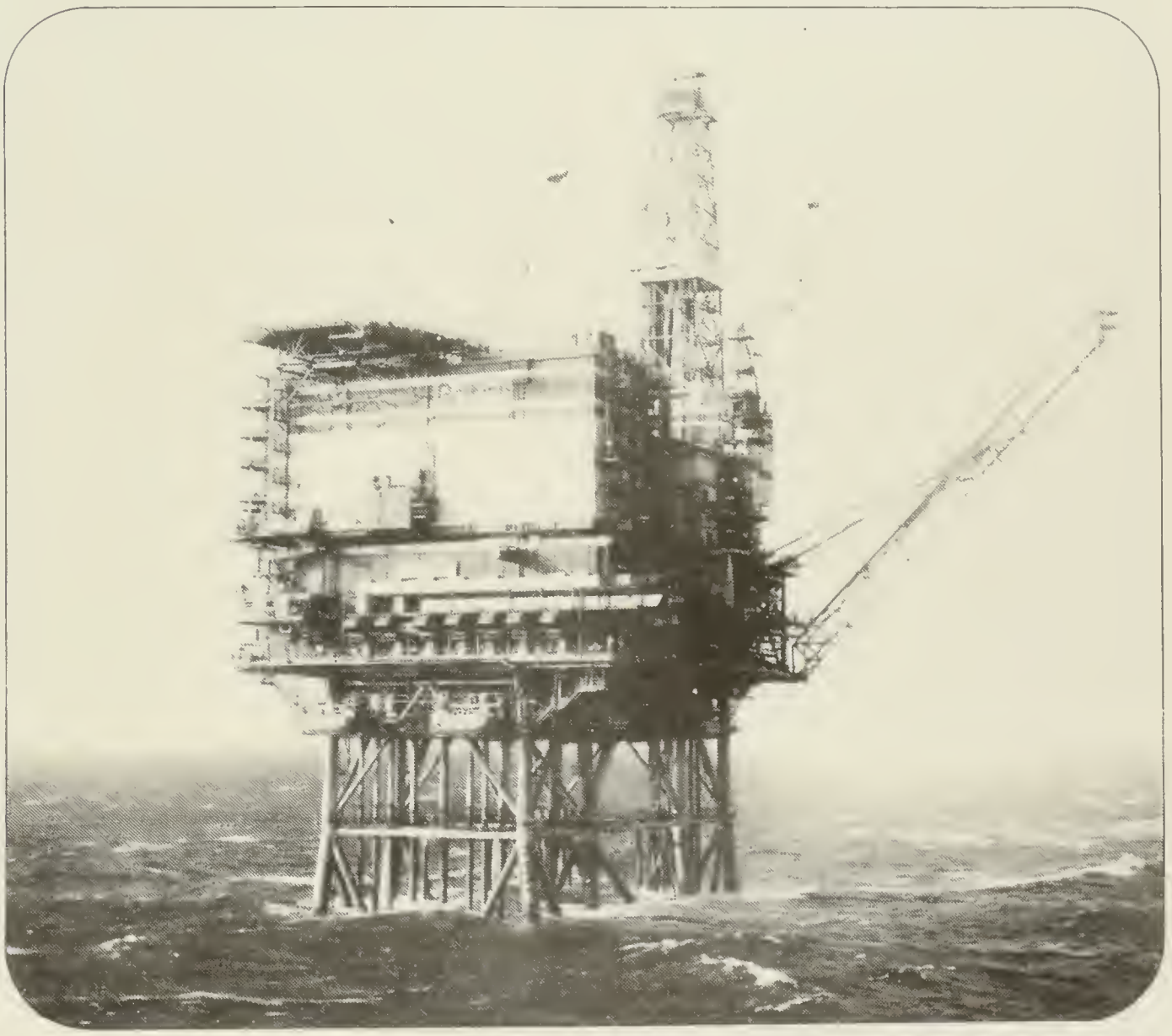

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